POWER

GENERATION, TRANSMISSION AND APPLICATION OF ALL THE POWER SERVICES

OCTOBER 1946

IN THIS ISSUE:

GAS TURBINES

A 20-PAGE SPECIAL SECTION

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BEFORE ▸

◂ AFTER

SLAG ASH HANDLING

Was Once a Problem

ABOVE—
Typical Hydrojet System for Intermittent Slag Tap Furnaces. This is the system shown in the above installation photo which was made in the same plant as photo in upper right.

RIGHT—
Typical Hydrojet Ash Handling System for modern continuous slagging furnaces.

Slag ash used to be tapped from the furnace and allowed to flow onto the basement floor; then, after it cooled, workmen dug it out with pick and shovel and loaded it into small cars. This was in 1927, and then (as now) we were called in to solve the new and unusual ash handling problem. With the assistance of the "pioneering-minded" engineers at this utility power plant, who on reading this will know whom we mean, we succeeded in solving this problem with a Hydrojet System. After this success on the Intermittent Slag Tap Furnace we were naturally called in years later when the Continuous Slagging Furnace presented new problems. Again we solved them, with the cooperation of some of the nation's leading engineers. Catalogs sent on request; and remember, "As always, A-S-H will pioneer in ash and dust handling."

ALLEN-SHERMAN-HOFF CO., 227 S. 15th St., PHILADELPHIA 2, PA. ***Offices & Representatives in Principal Cities***

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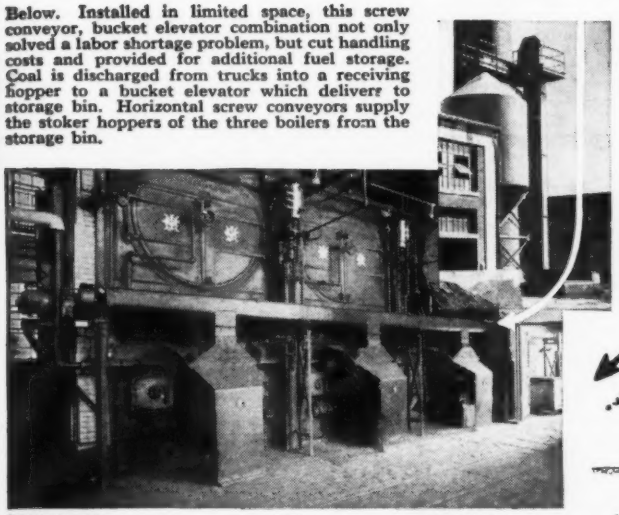
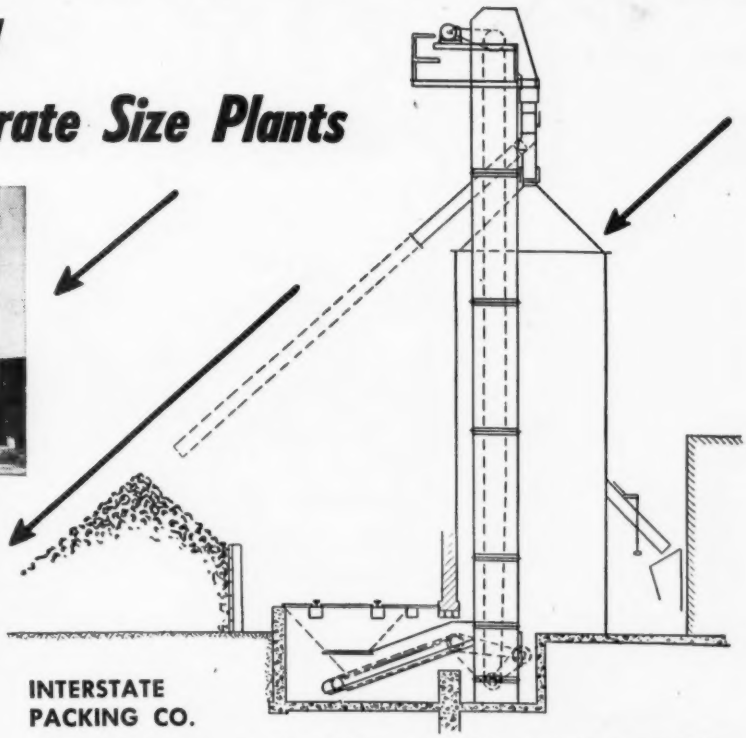
How Conveyor-Mechanization *Cut Steam Costs*

for These Small and Moderate Size Plants

Below. Installed in limited space, this screw conveyor, bucket elevator combination not only solved a labor shortage problem, but cut handling costs and provided for additional fuel storage. Coal is discharged from trucks into a receiving hopper to a bucket elevator which delivers to storage bin. Horizontal screw conveyors supply the stoker hoppers of the three boilers from the storage bin.

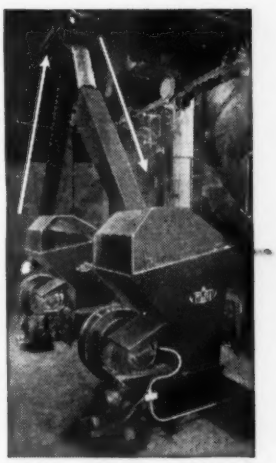




INTERSTATE PACKING CO.

This drawing shows a Link-Belt coal handling installation at this Wisconsin plant. It consists of track hopper, apron feeder, bucket elevator and storage bin. Coal is chuted direct from the bin to stoker hoppers with a detachable chute to outside storage. A simple and completely mechanized system that cut costs and increased efficiency.

Boiler room expansion with covered coal storage was accomplished at this plant without enlarging or raising roof of building or bunkers. Link-Belt elevator takes coal, delivered by truck, to silo with 20 ton live and 80 ton dead storage. Coal is spouted to boilers from this silo.



This ingenious, low-cost method of handling coal to the hoppers of two Link-Belt stokers from floor-level storage, utilizes an inclined Link-Belt screw conveyor with hinged discharge spout that permits coal delivery to either hopper as desired. This semi-automatic combination of screw conveyor and stokers is paying big dividends by cutting coal handling costs.

Vertical run of Link-Belt Bulk-Flo conveyor-elevator which delivers coal from storage pit outside boiler room wall to weigh larry. Slide gates in the wall lower the coal to the horizontal section of the Bulk-Flo. The vertical section delivers to a suspended weigh larry, equipped with chute, to hand-operated undercut gate, which regulates discharge to stoker hoppers. Bulk-Flo combines in a single unit, the functions of an elevator, a conveyor, and feeder with extreme flexibility of layout for coal and other flowable materials.

* * *

Whether your plant is large or small, and no matter what your conditions might be, there is suitable Link-Belt equipment to meet every requirement. Before you do anything else about it, talk over your problem with an experienced Link-Belt engineer. Send for Book No. 1510, "Solving the Problem of Coal and Ashes Handling."

LINK-BELT COMPANY

Chicago 8, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

10.103

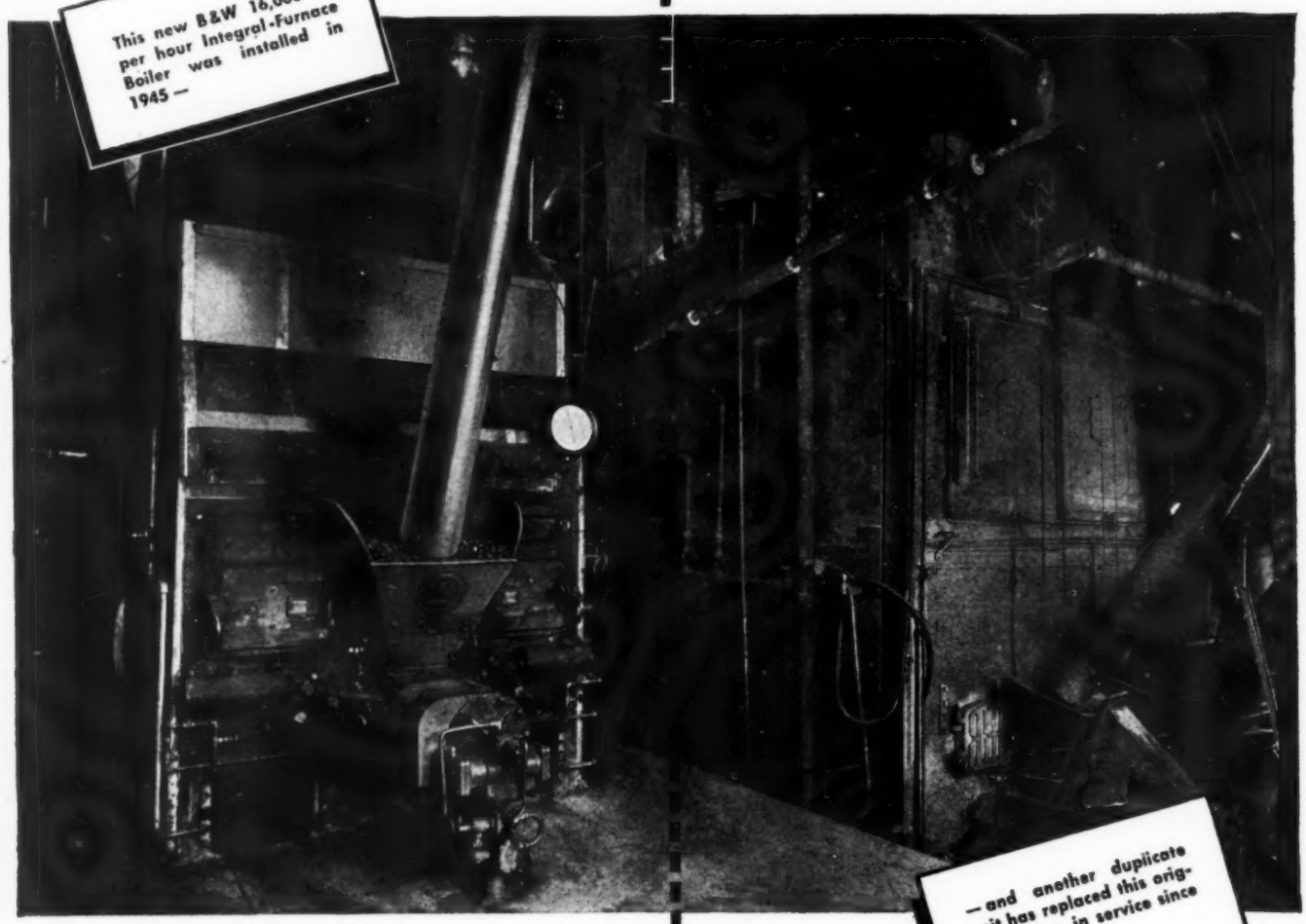
LINK-BELT

THE SYMBOL OF QUALITY — LINK-BELT COMPANY

COAL AND ASHES HANDLING EQUIPMENT

R v.90[3] Oct.-Dec. 1946

44 YEARS' PERFORMANCE


This new B&W 16,000 lb. per hour Integral-Furnace Boiler was installed in 1945—
—and another duplicate unit has replaced this original boiler, in service since 1901.

Distinctive Features of B&W Integral-Furnace Boilers that Assure Faithful Performance:

1. Water-cooled furnace sidewalls and roof are of the same durable stud-tube construction used in large central-station boilers.
2. Deep furnace, fired from one end, provides ample space for complete combustion.
3. Bare metal blocks cover and protect the tubes of the water-cooled furnace floor, provide a surface readily cleared of ash.
4. Self-draining superheater design prevents accumulation of water in the tubes, and a stud-tube wall shields the second and third banks from direct furnace radiation.
5. Tubes of the third bank, which is in the zone of coolest gases, act as down-comers, insuring rapid, positive circulation at all loads.

Tech

SELLS SATISFIED USER

TWO *MORE* B&W's

Again it's the story of "satisfied customer comes back for more" . . . a story that has been an old one with B&W for many years.

Old, too, were the boilers the story's about—two B&W longitudinal-drum boilers purchased by The Lunkenheimer Company of Cincinnati back in 1901—and still in daily operation at the time they were removed for plant expansion only last year.

In testimony to the performance of these veterans, the two new units that replace them also bear the B&W name. They are modern B&W Integral-Furnace Boilers, a type that has won sweeping acceptance in almost every major industry for high availability and continuity of service . . . for rapid response to fluctuations in load demands . . . for the production of clean, dry steam . . . for over-all economy with all types of fuel.

G-322-T

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
GENERAL OFFICES: 85 LIBERTY ST., NEW YORK 6, N.Y.
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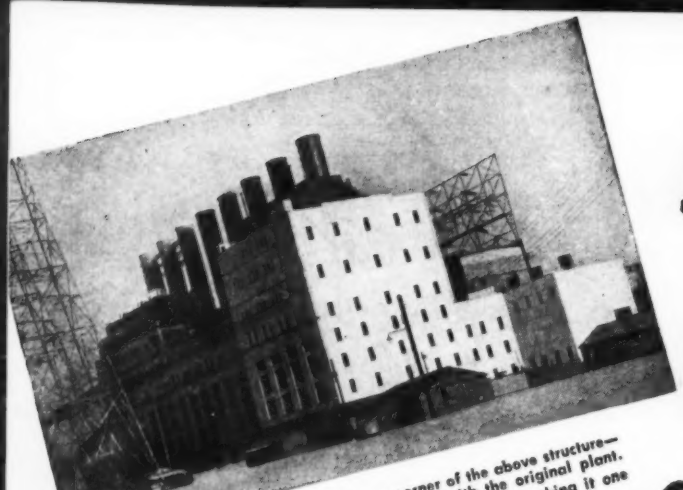
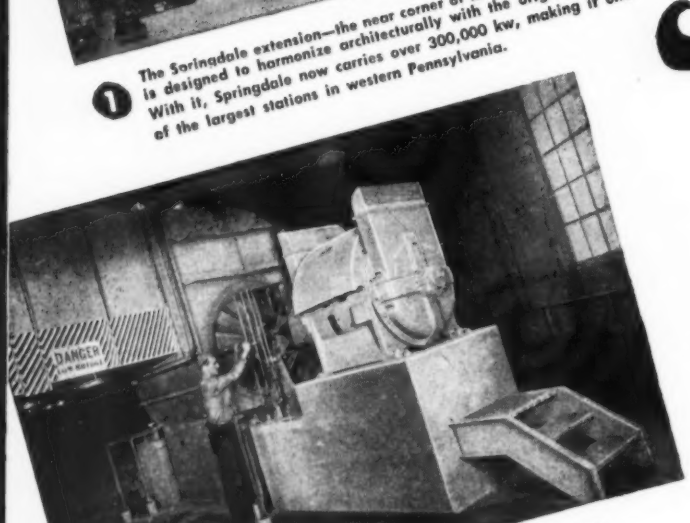
At Springdale vital motors



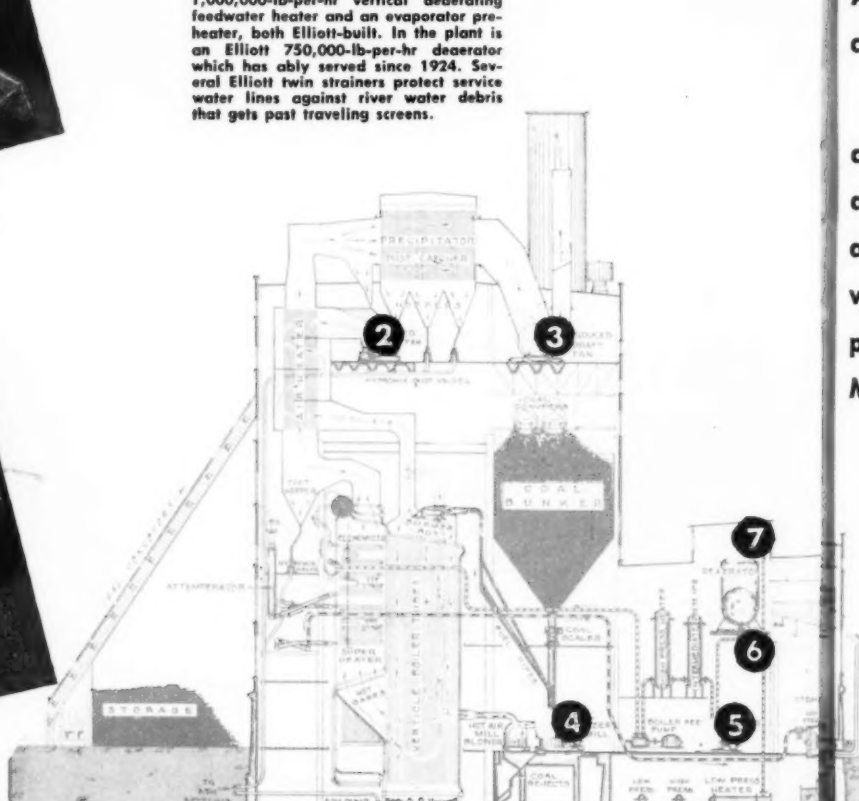
1 The Springdale extension—the near corner of the above structure—is designed to harmonize architecturally with the original plant. With it, Springdale now carries over 300,000 kw, making it one of the largest stations in western Pennsylvania.



2 One of the two Elliott 400 hp, 1200 rpm motors driving one of the forced-draft fans. These motors, with those which drive induced-draft fans, have duct attachment for taking filtered air from outside.

3 One of the two Elliott 700 hp, 720 rpm motors driving induced-draft fans. The windings are especially impregnated for boiler-room conditions.

7 In addition to motors by Elliott, the Springdale extension has also selected a 1,000,000-lb-per-hr vertical deaerating feedwater heater and an evaporator pre-heater, both Elliott-built. In the plant is an Elliott 750,000-lb-per-hr deaerator which has ably served since 1924. Several Elliott twin strainers protect service water lines against river water debris that gets past traveling screens.

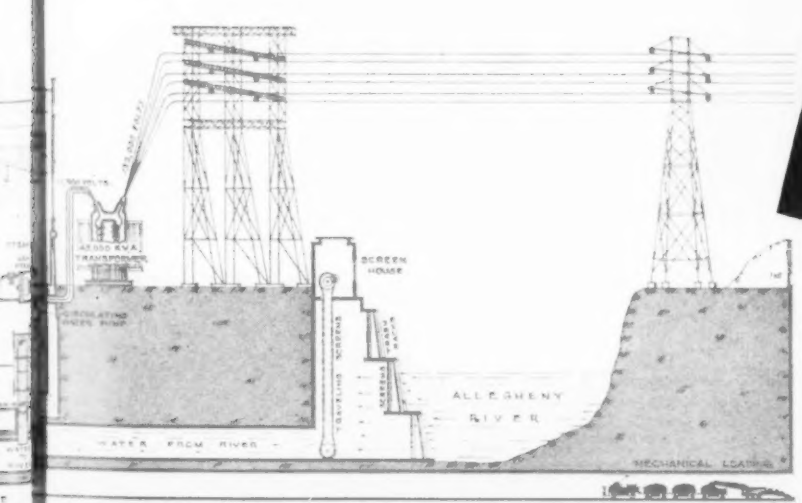


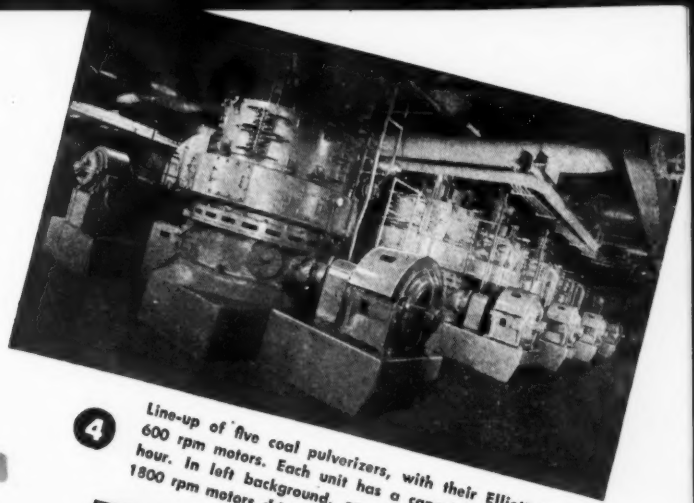
Elliott

by Elliott

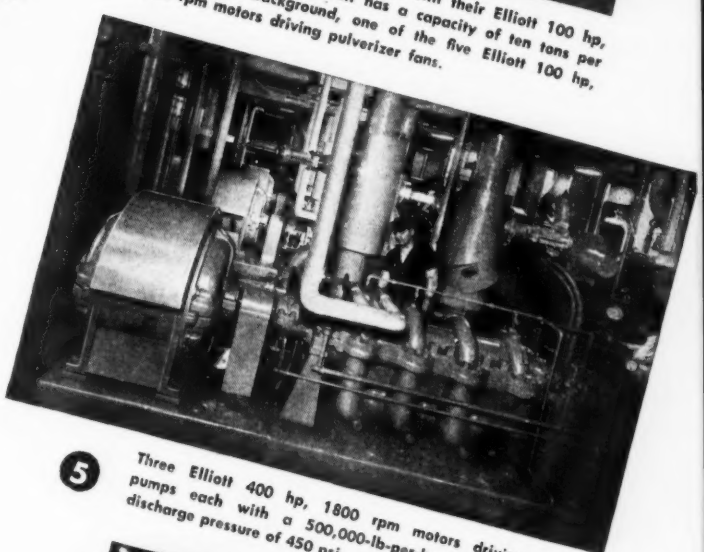
The new 65,000-kw addition to the Springdale Station of the West Penn Power Company, uses a number of Elliott motors for vital drives. The motors are all custom-built, with some unusual features. All are of the squirrel-cage induction type, in capacity ranging from 50 hp to 700 hp.

These motors are built, with traditional Elliott attention to detail, for the work they have to do and the conditions under which they do it. They are as reliable as careful engineering plus superlative workmanship can make them. Details of Elliott principles of motor construction are available in Motor Bulletins, on request.





4 Line-up of five coal pulverizers, with their Elliott 100 hp, 600 rpm motors. Each unit has a capacity of ten tons per hour. In left background, one of the five Elliott 100 hp, 1800 rpm motors driving pulverizer fans.



5 Three Elliott 400 hp, 1800 rpm motors driving booster pumps each with a 500,000-lb-per-hr capacity, with a discharge pressure of 450 psi.

6 Two Elliott 50 hp, 3500 rpm motors driving evaporator feed pumps, delivering deaerated water to all evaporators. In the background, an Elliott deaerator which was installed 22 years ago.

L-768

COMPANY

Electric Power Dept., RIDGWAY, PA.

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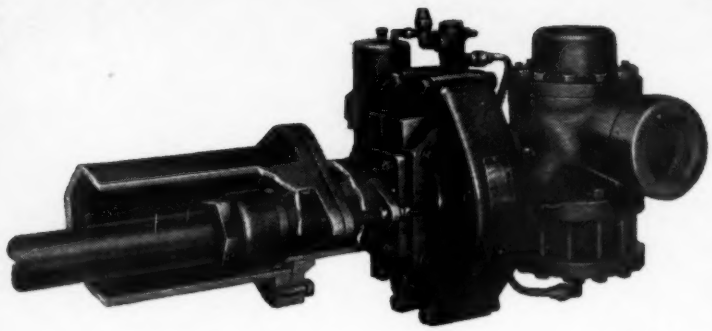
AND DEAERATORS • STEAM JET EJECTORS
CENTRIFUGAL BLOWERS • TURBOCHARGERS FOR DIESEL ENGINES
TUBE CLEANERS • STRAINERS • DESUPERHEATERS • FILTERS

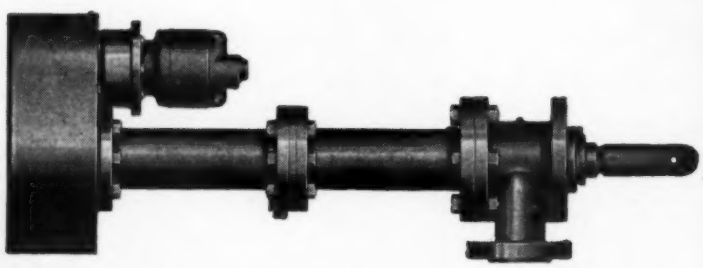
LOWER OPERATING COSTS

BETTER BOILER CLEANING

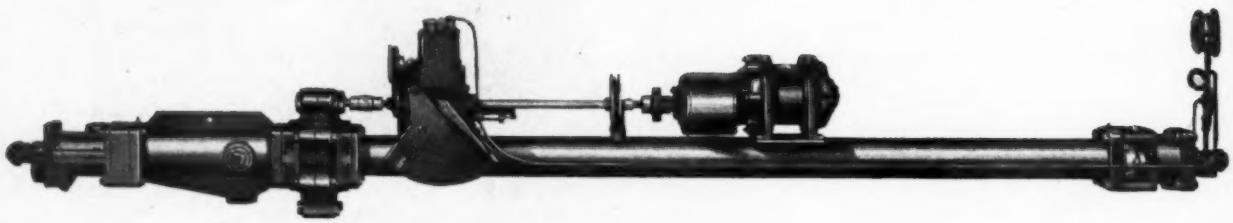
Diamond Program panel controls both fixed and retracting blowers (on boiler, superheater, economizer and air heater). Any desired number of groups can be had when system is designed, but panel shows three groups. Entire soot blowing system is operated automatically in proper sequence and at correct speed by simply pushing "start" button. Any group can be operated independently by simply throwing a switch on control panel.



Diamond "Air Puff" Soot Blower having element permanently installed inside the setting. Compressed air for cleaning is discharged from nozzles in a series of short puffs with substantial pauses between which permits use of a much smaller compressor. Air operation automatically rotates element to new position during each puff. Designed with large valve and large air passages to minimize pressure drop.



Diamond Model IF Retracting Soot Blower (at right) uses compressed air as the cleaning medium and is electrically operated.



Diamond "Telescopic" Soot Blower uses compressed air (or steam) as the cleaning medium and is electrically operated as shown; air operation also available.

RESULT FROM

DIAMOND

AUTOMATIC SEQUENTIAL

SOOT BLOWING with AIR

Soot and slag removal with compressed air instead of steam has a number of important advantages that make for lower operating costs as well as better boiler cleaning. Air eliminates the expense of boiler feed-water makeup, and saves energy from the coal pile. Air provides a dryer medium which is particularly desirable for surfaces operating near the dew point. Air is a more effective medium for slag removal because of its greater density and lower temperature. Air requires less blower maintenance on the basis of experience on installations in service since 1940. Air requires no piping insulation. Air permits better control of fly ash flow and grain loading of gas to dust collectors or to atmosphere. Air, when introduced intermittently instead of continuously, eliminates upset operating conditions during soot blowing period.

Other important advantages that are common to all Diamond Automatic Sequential Soot Blower Systems (steam as well as air) are a saving in labor and the elimination of the "human element" which assures that all blowers are operated in proper sequence and at correct blowing speed every time they are operated. Blowers can be either electrically or air operated and controlled —or a combination of both. System can be remotely operated from boiler control board or most convenient location.

Write for further information regarding Diamond Automatic Sequential Air Soot Blowing Systems that have been giving very satisfactory service on boilers as large as 900,000 lb/hr since 1940.

SPECIALTY CORP. Detroit 31, Mich.

DIAMOND SPECIALTY LTD. • Windsor, Ontario

Remember this Fact— Wet Coal Won't Clog This Stoker!

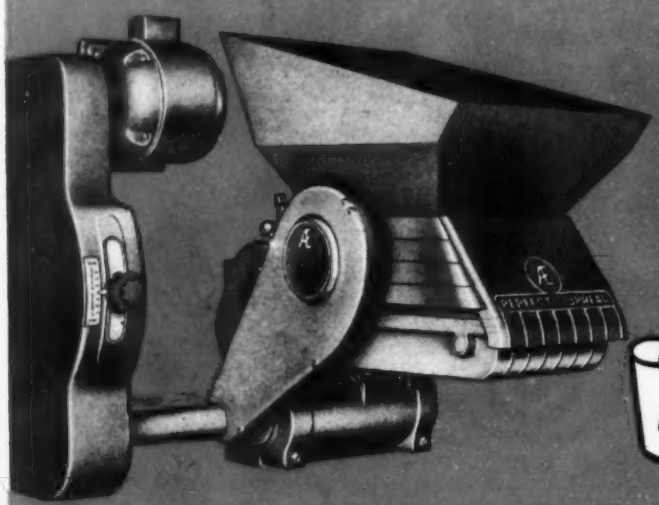
Of all the features, of all the extra advantages of the Perfect Spread Stoker this ONE is outstanding. Yes, we repeat—*wet coal won't clog this stoker!* Fill the hopper with the lowest grade coal available—wet, partially frozen or dry—and you get *continuous* feeding for the most efficient production of steam at the lowest cost.

When you check its other features, when you see its simplicity of design, when you notice its almost silent operation you'll understand why today's Perfect Spread Stoker is a *must* for today's boiler room—and for many years to come.

Get the details! Write for the completely descriptive folder!

Æ

PERFECT SPREAD STOKER



—with stationary grates, dumping grates or continuous ash discharge—up to 400,000 lbs. of steam per hour.

Won't Clog on Wet Coal!

PROVED IN PERFORMANCE FOR 17 YEARS

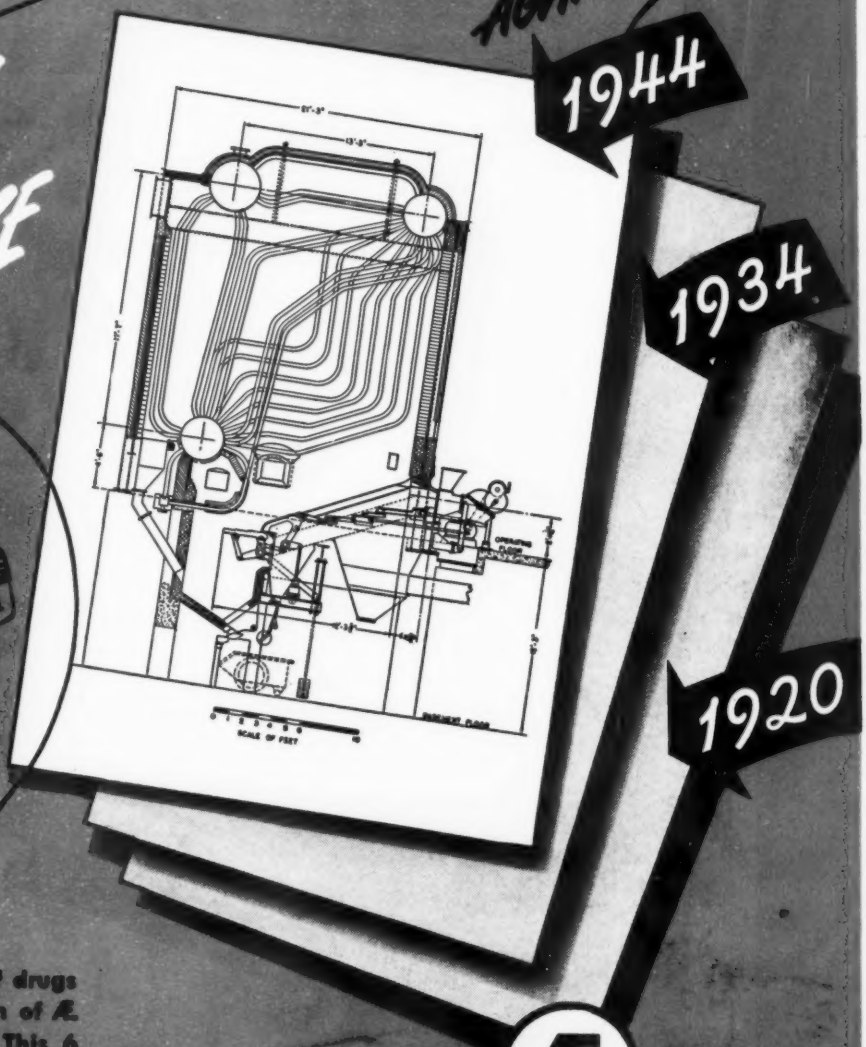
Today's Perfect Spread Stoker provides significant improvements to a product with a 17 year record of successful performance in 15 industries. Investigate this improved Perfect Spread Stoker.

Other Æ Products: Æ Taylor Stokers, Lo-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power

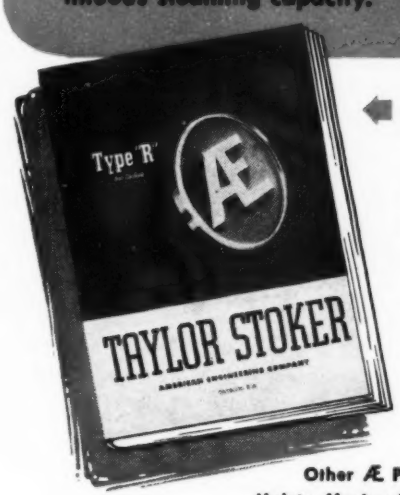
AMERICAN ENGINEERING COMPANY

2400 ARAMINGO AVENUE, PHILADELPHIA 25, PENNSYLVANIA

Repeat Orders PROVE PERFORMANCE



A world famous manufacturer of drugs has completed its 3rd installation of Æ Taylor Stokers with the type R. This 6 retort, 25 tuyere continuous ash discharge stoker develops 50,000 lbs. per hour continuous steaming capacity.



GET THE FACTS ON THE IMPROVED TYPE R

This easy to read 18 page bulletin will quickly bring you up-to-date on the advantages and improvements in stoker operations as provided by the Æ Taylor Stoker. Write for it!

TAYLOR STOKER

AIR-COOLED & WATER-COOLED

The Only Underfeed Stoker with *all* these Features IN COMBINATION!

1. Continuous Self-Sealing Ash Disposal
2. Movable Ash Discharge Plates
3. Smooth-Flow Hydraulic Drive on Rear End
4. Independent Pusher Controls within 1/8 inch
5. Unique Sure-Feed Coal Agitators
6. Silent-Shift Spur Gear Planetary Power Transmission

Other Æ Products: Æ-Perfect Spread Stoker, Lo-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power.

AMERICAN ENGINEERING COMPANY

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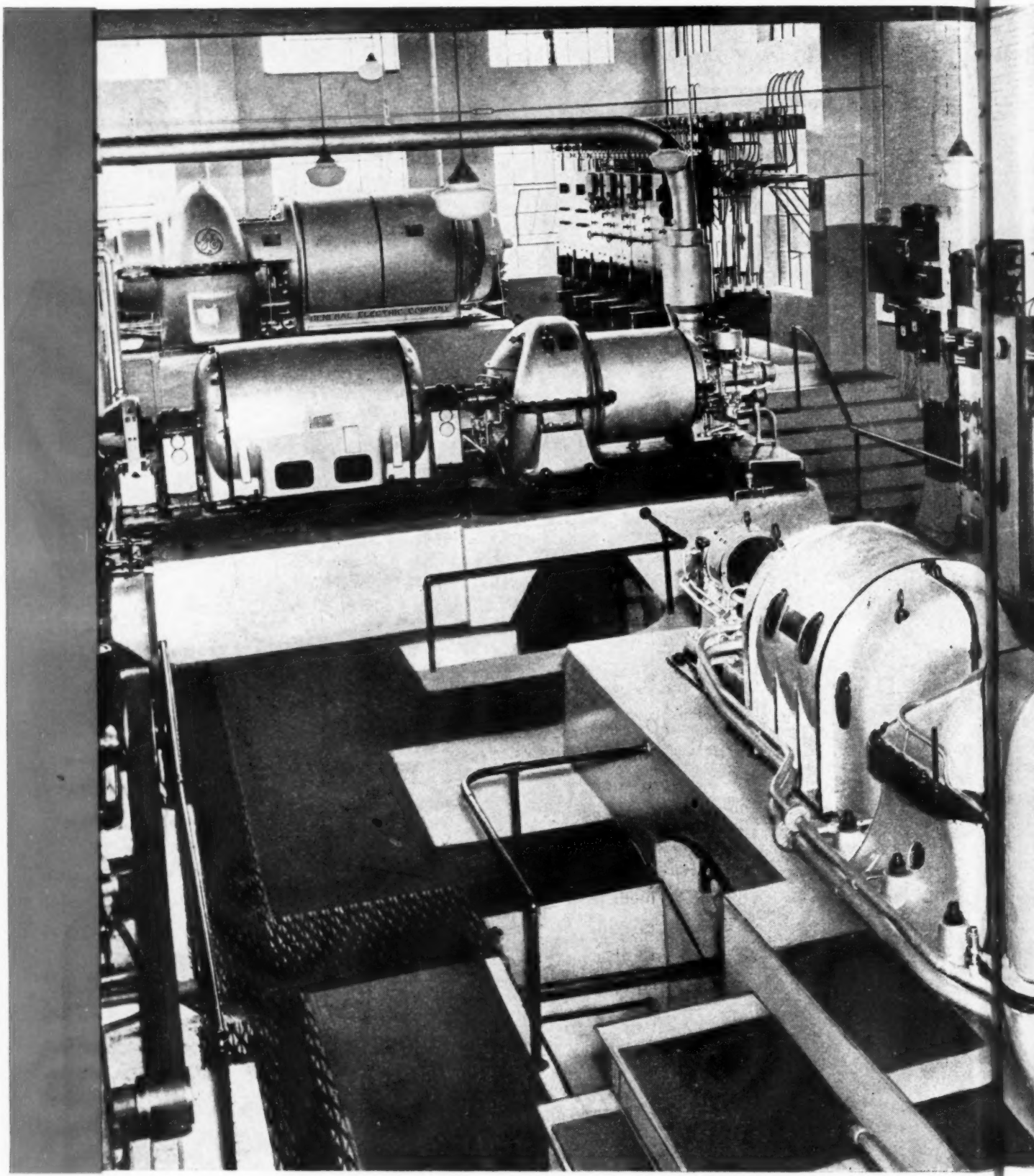

TUNE IN THE
TEXACO STAR THEATRE
EVERY SUNDAY NIGHT
— CBS

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KEEP TURBINES FULLY PROTECTED

TEXACO Regal Oils (R & O) will give your turbines, old or new, *full* protection. These are the world-famous Texaco Regal Oils *improved* by special rust and oxidation inhibitors.

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Texaco Regal Oils (R & O) fully meet specifications of all leading turbine builders, and the turbine oil specifications of the U. S. Navy.

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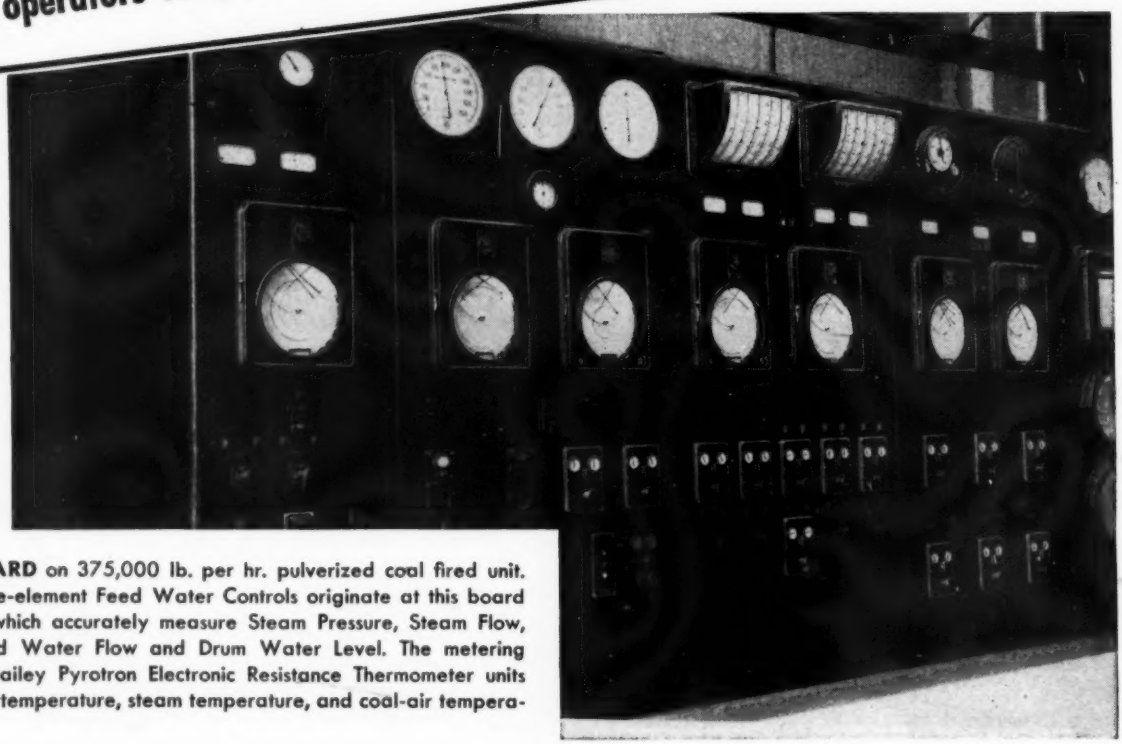
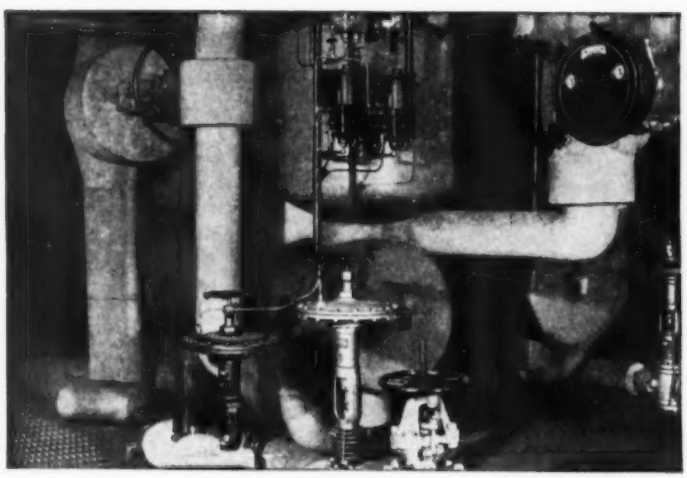
FOR ALL TURBINES

Dedicated to Optimum Steam Plant Performance

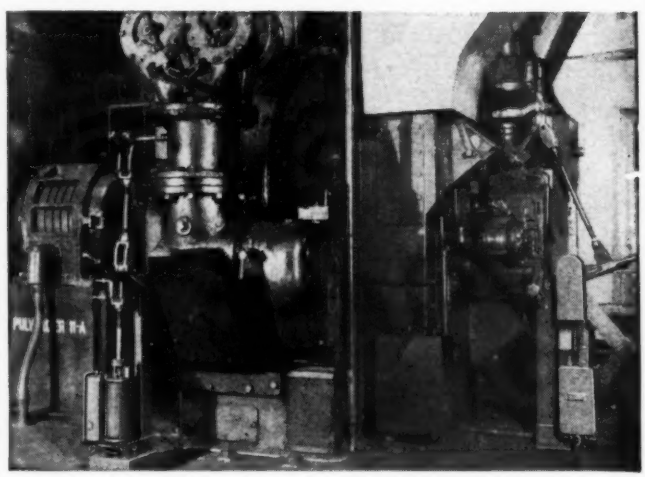
Bailey Controls at Williamsburg Station of Pennsylvania Edison Co. help operators to secure Safety, Economy and Continuity of Service



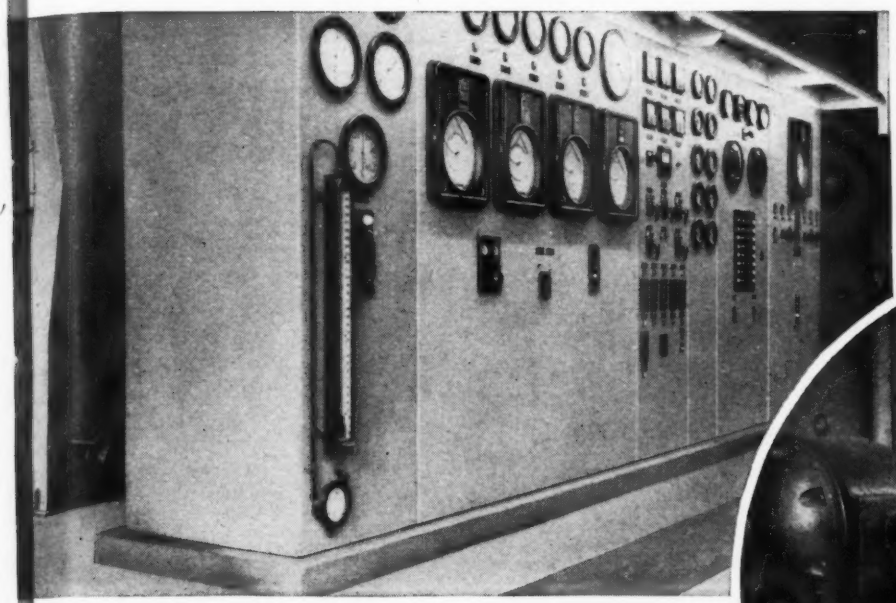
BAILEY BOILER BOARD on 375,000 lb. per hr. pulverized coal fired unit. Combustion and Three-element Feed Water Controls originate at this board from Bailey Meters which accurately measure Steam Pressure, Steam Flow, Air Flow, Draft, Feed Water Flow and Drum Water Level. The metering equipment includes Bailey Pyrotron Electronic Resistance Thermometer units to record feed water temperature, steam temperature, and coal-air temperature at each mill.



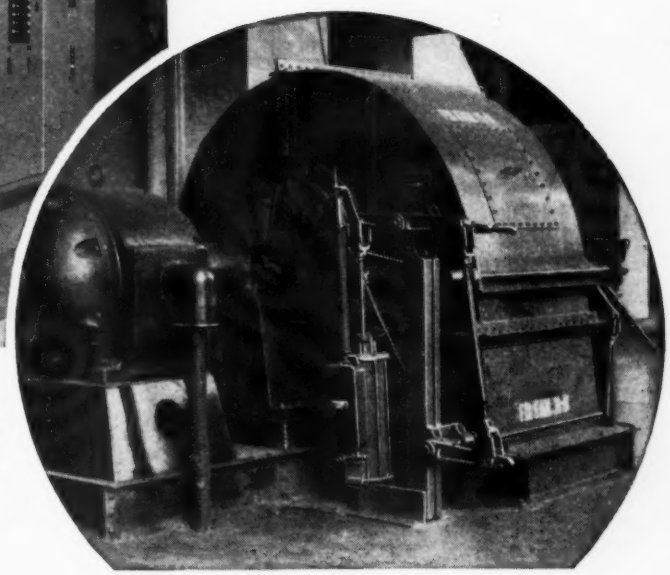
HEATER DRAIN CONTROL. Bailey Level Controller and relays regulate drain valves to maintain the desired high pressure drainer level.



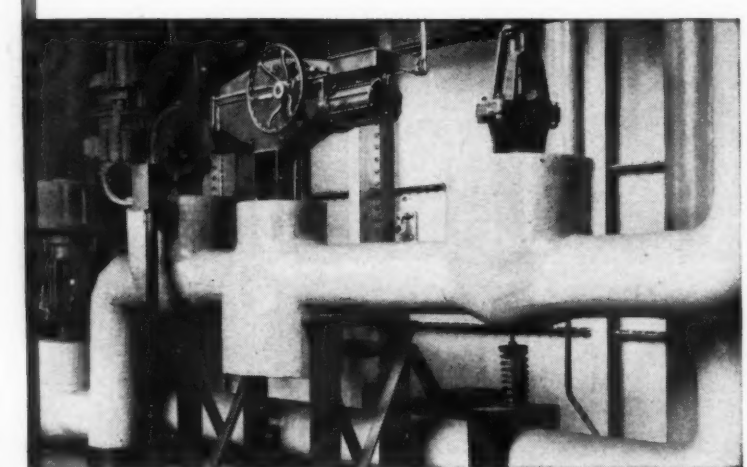
PULVERIZER CONTROL. These Bailey Control Drives regulate raw coal feed and coal-air output from a Riley Atrita Pulverizer in accordance with boiler load demand as measured by the Bailey Master Steam Pressure Controller.



TURBINE BOARD. A Bailey Three-element System of condensate control originates at this board from the first three recording meters which measure: (1) Total flow output from high pressure boiler feed pumps, (2) Condensate flow to No. 1 Heater, (3) Level in No. 3 Heater. The fourth meter records and integrates steam flow to the high pressure turbine and a fifth meter records pressure and temperature of desuperheated steam.

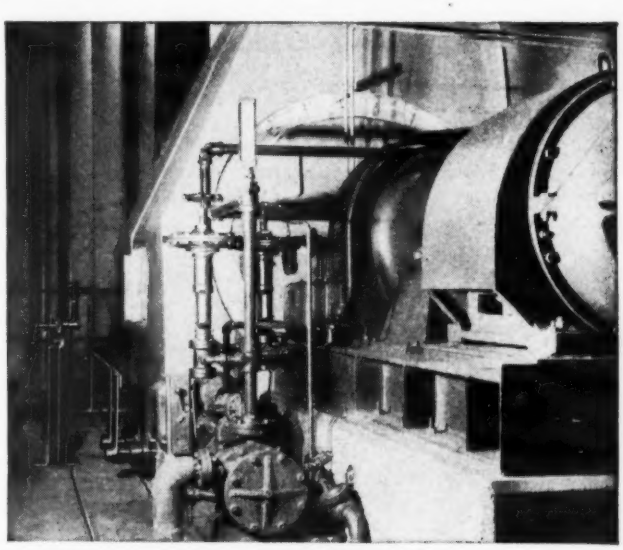


FORCED DRAFT FAN CONTROL. Bailey Control Drives position inlet vanes to supply air for combustion in accordance with the requirements established by the Master Steam Pressure Controller and the Bailey Boiler Meter.



BAILEY THREE-ELEMENT FEED WATER CONTROL VALVE. This powerful valve regulates feed water input to the boiler so that it equals steam output and maintains a safe drum level at all times. Control impulses originate from the accurate measurements of Bailey Meters on the Boiler Board.

All photos by the courtesy of Burns & Roe, Inc. For more information on coordinated Boiler Control Systems, such as installed at the Williamsburg Station, ask for Bulletin 15-C.



INDUCED DRAFT FAN CONTROL. Bailey Control Drive and Valves regulate the induced draft damper and the hydraulic coupling fan speed control to maintain the desired furnace draft.

A-96

BAILEY METER COMPANY

1036 IVANHOE ROAD • • • CLEVELAND 10, OHIO

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

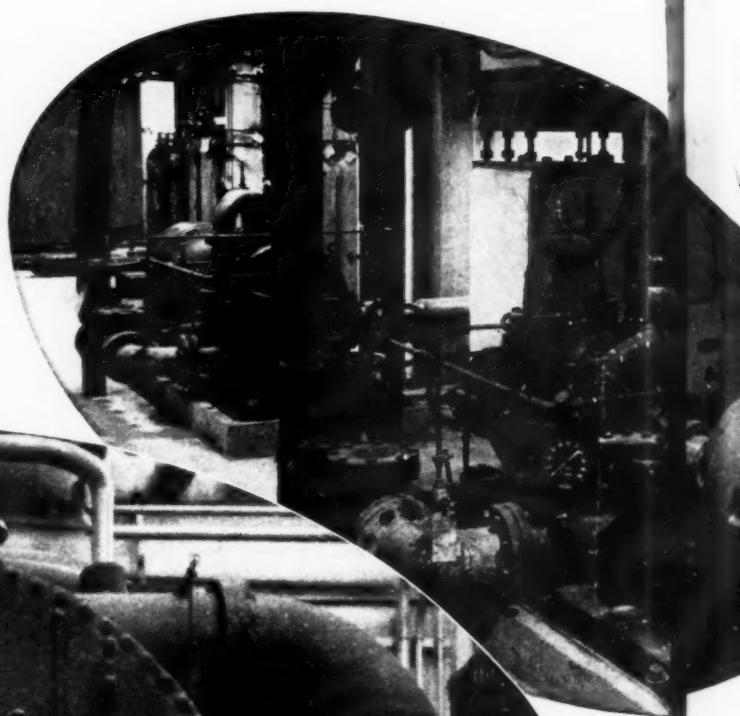
Controls for Steam Plants

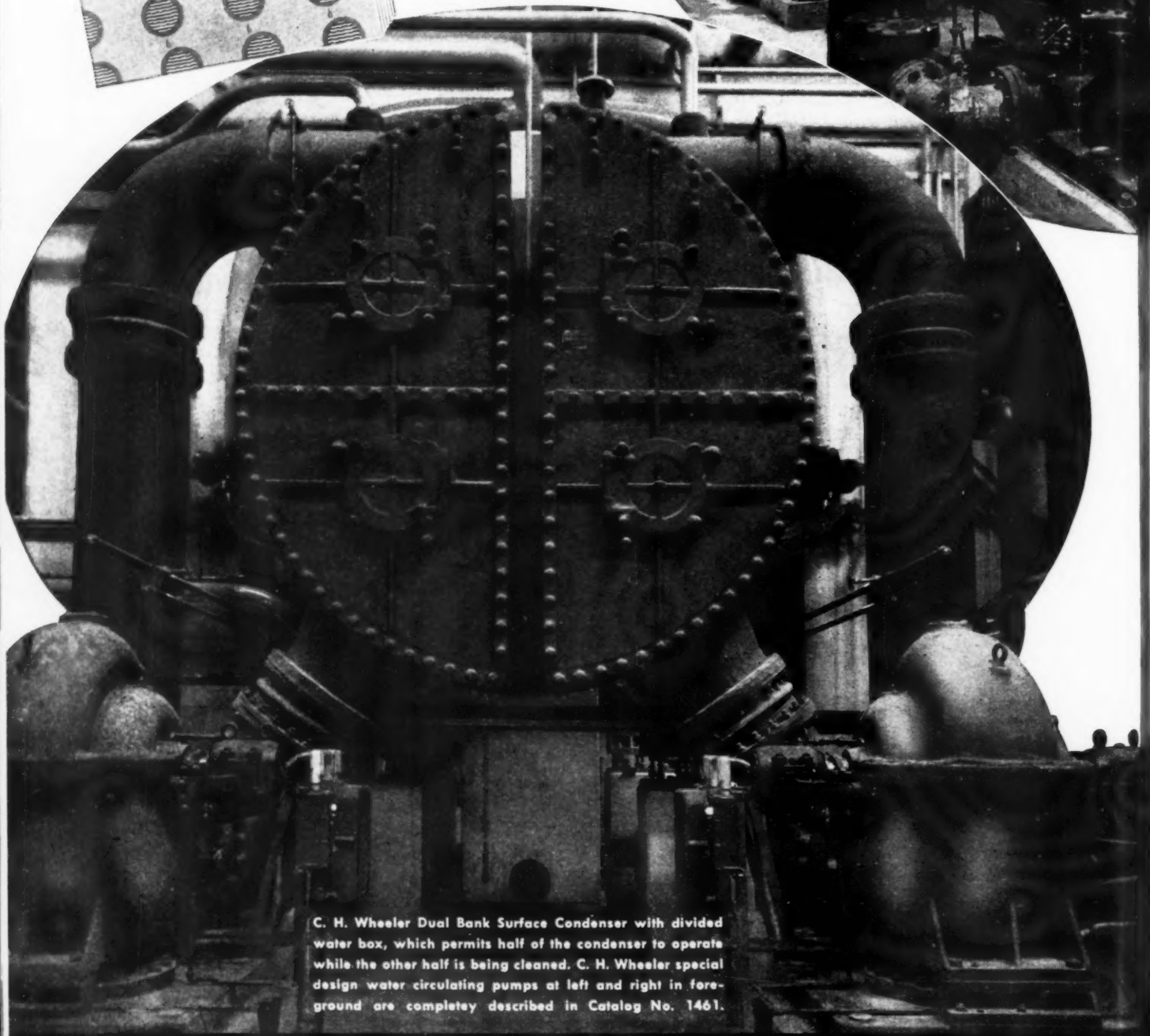
Installation of two, 3-stage Condensate Pumps of our special design for this service. These pumps are fully described in our new 44 page Condenser Catalog.

New Catalog

WRITE FOR IT TODAY

Our 44 page Catalog No. 1461 entitled "Steam Condensers" contains pictures and descriptions of our complete line of Dual Bank Surface Condensers and Jet Condensers of both Barometric and Low Level Types; also includes Steam Jet Air Ejectors, Pumps, etc., plus many pages of useful engineering information, tables, charts, etc.





C. H. Wheeler Dual Bank Surface Condenser with divided water box, which permits half of the condenser to operate while the other half is being cleaned. C. H. Wheeler special design water circulating pumps at left and right in foreground are completey described in Catalog No. 1461.

C. H. Wheeler

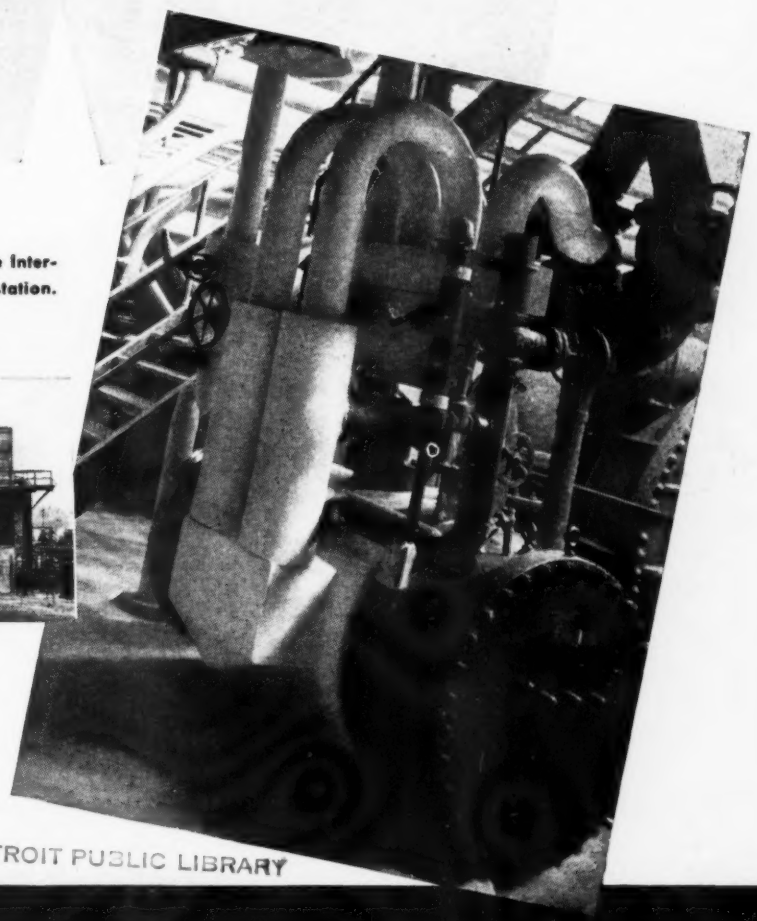
Steam Condensers – Cooling Towers
and a Complete Line of Accessories

We don't make "almost everything" for a steam power plant and we don't make just one thing; however, we do specialize in one group of allied products and have been doing so for over fifty years. We feel that our range makes us large enough to maintain a competent staff and an adequate shop for the largest jobs, yet not too big to give careful, personal attention to the small jobs. Our steam condensers have tubes arranged in a "Dual Bank" design, which gives deep penetration for the entering steam and produces condensate temperatures corresponding to the vacuum. They are built in all sizes and types. We built the first condenser to which the steam jet air ejector was successfully applied back in 1916 and have been building ejectors, now known as Tubejet, ever since. Write for our new 44 page catalog featuring our Steam Condensers and allied products.

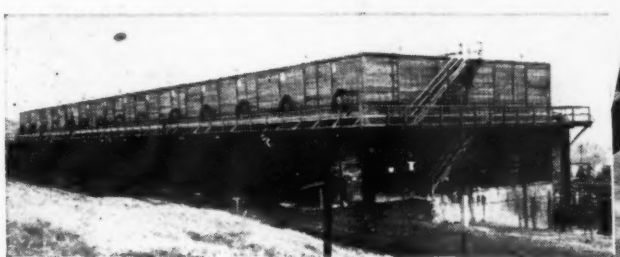
C. H. WHEELER MANUFACTURING CO.

1800 SEDGLEY AVENUE, PHILADELPHIA 32, PA.

REPRESENTATIVES IN MOST PRINCIPAL CITIES



Tubejet Steam Jet Air Ejector with Surface Type Inter-After Condenser, as installed in a central station.



Water Cooling Towers of both Induced and Forced Draft Types, correctly engineered for any climatic condition. Send for our 20 page Catalog No. 145.

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STEAM CONDENSERS • AIR EJECTORS
COOLING TOWERS • HEAT EXCHANGERS
OF PHILADELPHIA

Scovill Tube News

Vol. 4 SCOVILL MANUFACTURING COMPANY, Waterbury 91, Conn. No. 3

Fresh vs. Salt Water

Effects on Condenser and Heat Exchanger Tubes

It is generally well known that condenser tubes in an installation using fresh, natural cooling waters will have normally a longer life than tubes in a similar installation in contact with salt or brackish water. It has also been observed that in a fresh water installation in which tube life has been 20 years or longer, replacement tubes in the same unit may fail after a shorter period. Many times, periodic water analyses will give some clue as to the cause of the drastic change. In some cases, although it is known that contamination of the water supply has been responsible for failures (as for example, by pollution or the presence of suspended solids, etc.), the seriousness of this condition is not always reflected in a water analysis.

FRESH WATER

In any given water there are certain components which are much more detrimental to the life of condenser tubes than others. Also the corrosion of tubes may not be a direct chemical attack of the particular compound but may be a secondary reaction resulting from the deposition of salts of that constituent.

Carbonates

Water with 350 ppm of Bicarbonates would not be considered as corrosive to brass condenser tubes. However, the chief trouble with water of this type is the heavy scaling of tubes resulting from the precipitation of carbonates from the water onto the tube surfaces. Due to this reaction, pitting might be encountered as a result of concentration cell action and relatively severe dezincification of certain brasses might take place under some particular conditions of service. Fortunately, water treatments may be used to prevent deposition of calcium carbonate. Also Phosphorized Admiralty can be installed if dezincification is a problem.

ph Value

The acid properties of solutions are due entirely to hydrogen ions and the determination of the ph of a solution, together with knowledge of other factors and service conditions, is helpful in the correct interpretation of the problem. Natural water having a ph of 4.0 or less would be considered dangerously acid; this condition might be caused by contamination from chemical or manufacturing plant wastes or from acid drainage from coal mines into streams. Serious corrosion of tubes may result, depending on the acid concentration and the presence of oxidizing agents such as ferric sulphate. Acid waters bring about a relatively rapid uniform thinning of tubes under certain conditions; by proper water treatment, attack of this kind usually can be minimized.

Carbon Dioxide

Relatively high concentrations of free CO_2 in water react as an acid (carbonic acid) and thereby accelerate corrosion of condenser tube material resulting in a general thinning of the tube wall. In the presence of dissolved oxygen this action is accelerated. Chemical treatment of such waters can minimize this action.

Chlorine

Chlorine dissolves in water with the formation of hydrochloric and hypochlorous acids which are very corrosive. Fortunately, chlorine is not normally found in natural water and, in the amounts usually added for the control of bacteria and algae, it has no appreciable effect on corrosion.

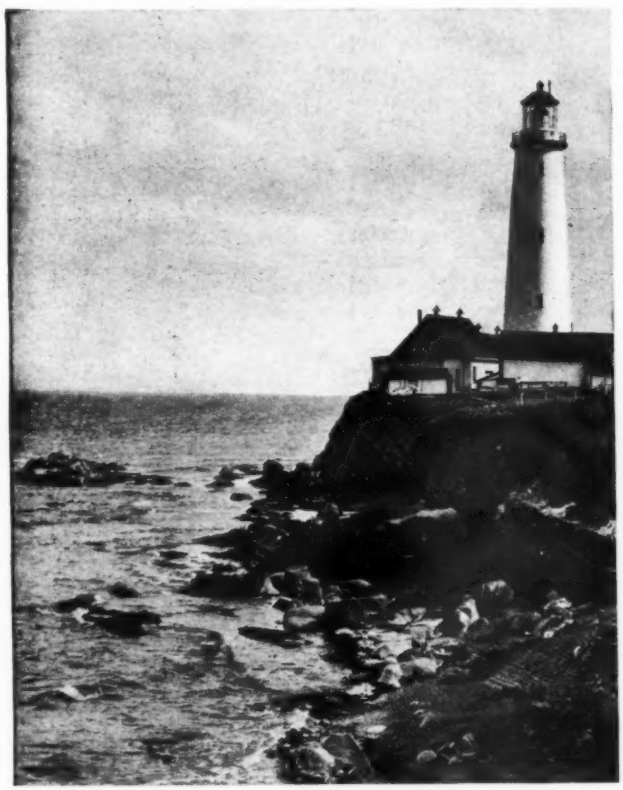
Hydrogen Sulphide

Hydrogen sulphide is a very active corroding agent and being an acid attacks most metals. Oil refinery and industrial wastes, sewage, and peaty soils are responsible for high concentrations of hydrogen sulphide sometimes found in water supplies. When in high concentrations, severe pitting of the tube surface results.

As a general rule, corrosion of copper-base alloys is not serious in contact with fresh water since the choice of the proper alloy and treatment of water can be controlled to keep attack to a minimum. An increase in the rate of attack, when attributed to changes in the water, is usually associated with a radical change in one of the above components. If such change can not be controlled by water treatment, shorter tube life results.

SALT WATER

Salt water, which normally contains about 30,000 ppm of chlorides or approximately 3% sodium chloride and minor amounts of potassium and magnesium chlorides and sulphates, is not in itself a serious corroding agent of copper-base alloy condenser tubes. The shorter life of condenser tubes which may be experienced in salt water installations, however, is due to appreciable amounts of trash, wastes and other substances. Depending on the location, the season of



the year, the depth of water at the intake, and other factors, these substances may or may not accelerate corrosion measurably. Compounds such as carbon dioxide, hydrogen sulphide and ammonia may occur only seasonally in harmful amounts.

Concentration Cell Action

It is known that carbon dioxide and hydrogen sulphide in sea water may produce a non-protective deposit over the metal surface which would promote the formation of concentration cells and result in intense localized pitting. Since the electrical conductivity of salt water is very much higher than fresh water, due to the ionization of the salts in solution, the attack resulting from concentration cell action would be much more severe than in fresh water. Concentration cell action is electro-chemical in character and is due to potential differences between adjacent surface areas where a difference exists in the concentration of salts, ions or gases.

The rate of attack resulting from compounds that cause trouble in fresh water is measurably increased in salt water, due to the greater concentration of ions and the resultant higher conductivity. Control of these compounds in salt water is very difficult. Also, in salt water it is not unusual to have hydrogen sulphide, ammonia, and carbon dioxide present simultaneously.

Any electro-chemical type of corrosion such as dezincification, galvanic action, and concentration cell action is much more severe in salt than in fresh water. This action alone helps to explain why salt water installations may have measurably shorter life than similar fresh water installations. In this same respect, types of corrosion common to both salt and fresh water such as erosion-corrosion and deposit attack are more severe in salt than in fresh water.

Three Scovill Services

Service in Manuals, of which "Scovill Tube News" is a sample, consists of literature providing the latest, most authentic information* on condenser and heat exchanger tubes, which has its source in the broad experience of our engineers and the findings of our laboratories. *Service in Men* offers specialized consultation on individual tube application problems and suggestions regarding alloy selection and tube installation practice. *Service in Metals* includes the development and production of a wide range of tube alloys under laboratory control, which verifies that Scovill alloys conform to specifications.

*For a free copy of the Condenser Tube Booklet, address Scovill Manufacturing Company, 13 Mill Street, Waterbury 91, Conn.

This is Number Nineteen in a series of Scovill advertisements to help you get longer life from condenser and heat exchanger tubes.

SCOVILL

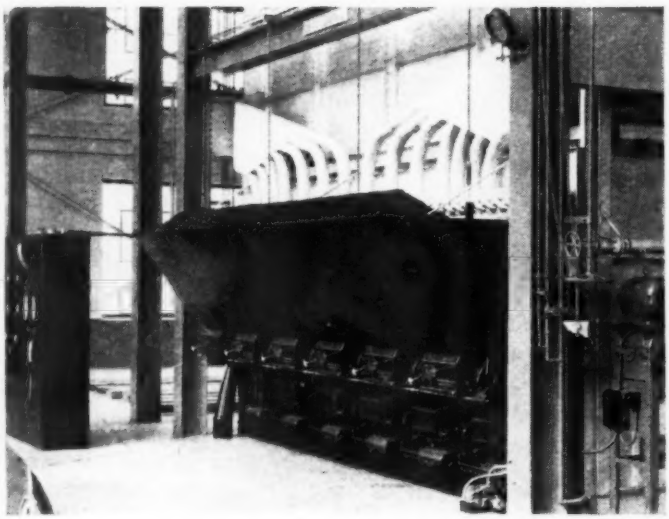
SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

Firite HOFFMAN

The HOFFMAN FIRITE is the original forced draft spreader type stoker . . . the pioneer of its kind . . . A product of 25 years of continuous refinement. Engineered for long life and low maintenance.



COAL FEEDING UNITS

FIRITE coal feeder units are of the mechanical spreader type using the underthrow principle, and a loose impeller mechanism consisting of a main impeller shaft with large dust-sealed water-cooled bearings; equipped with four concentric shafts on which are suspended—in series—loose impeller blades which are held in operating position by centrifugal force, and which provide ample clearance for tramp iron and other reasonably large refuse which may be in the fuel supply.

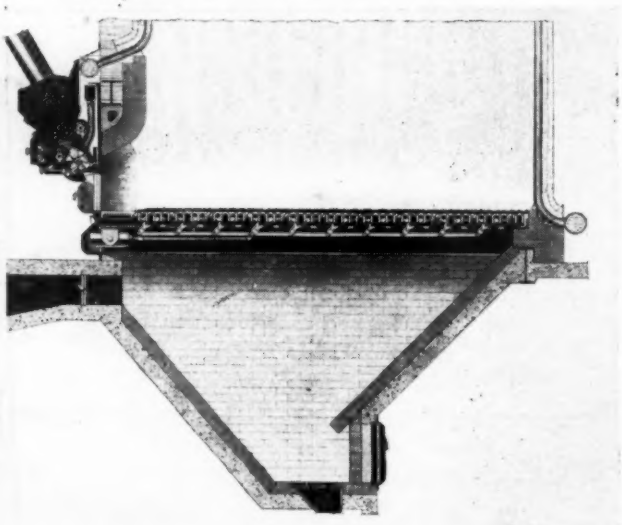
The impeller mechanism operates at low speed. All bearings are dust-sealed and of ample size. Interior wearing surfaces are equipped with patented replaceable liners.

The coal flows by gravity from the hopper to a reciprocating coal feeder plate, which delivers the coal to an adjustable tray having a machined curved face, from which the coal is picked up by the revolving impeller mechanism and delivered to the furnace, accomplishing a uniform spread over the entire grate area by means of the unique curvature of the impeller blades.

MANUAL ADJUSTMENTS—Quick manual adjustments are provided to maintain uniform spread over wide fluctuations in sizes and surface moisture conditions of the coal supply.

Dumping Grates, either power or manually operated will fit any furnace width, due to the flexible design.

In laying out a furnace arrangement, first determine the proper width of grates and then determine the length by increments of 15 inches to obtain suitable projected area for correct combustion rates.



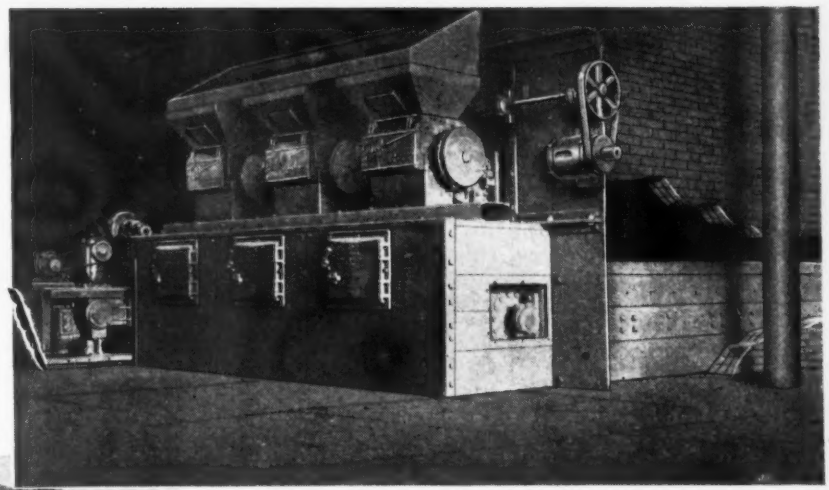
HOFFMAN COMBUSTION

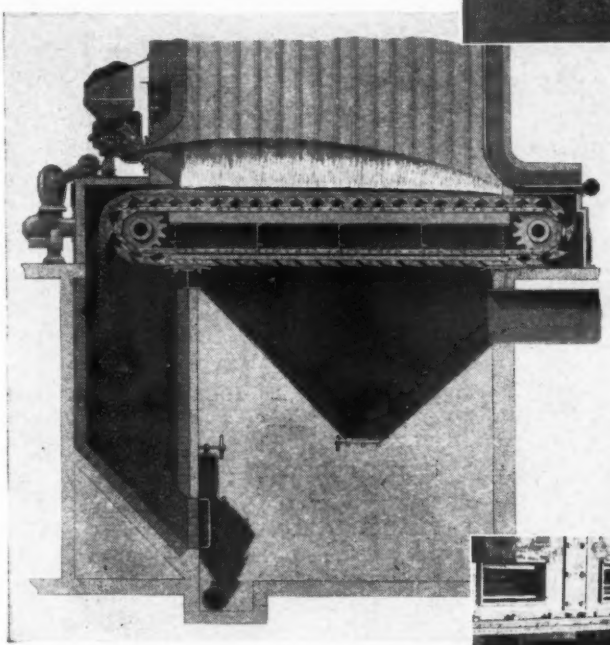
WORKS AT: FAIRMONT, WEST VIRGINIA
DETROIT, MICHIGAN

STOKERS

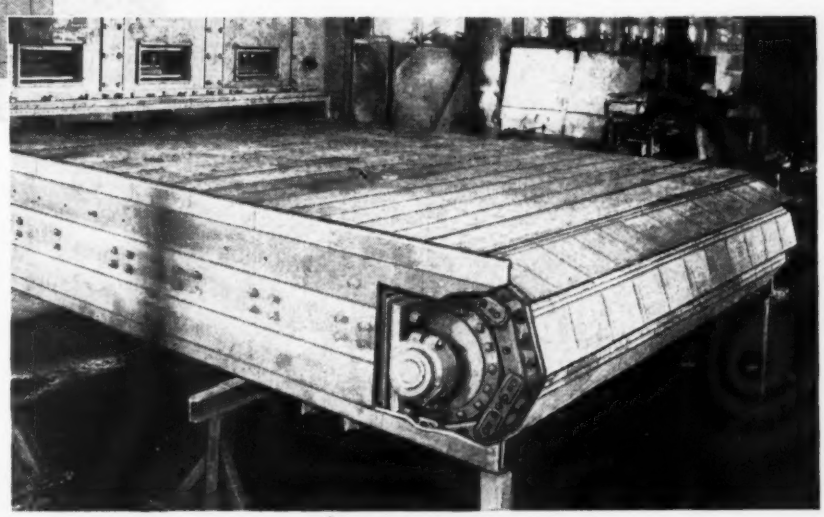
Firite

Hoffman Firite Spreader Type Stokers equipped with Hoffman Continuous Ash Discharge Grates, may be designed for either front or rear discharge to suit local plant conditions.





- **Expansion and permanent growth of grate structures due to furnace temperatures are absorbed in expansion joints, provided in the design.**
- **Any expansion in grate structure will not be transmitted to the moving carriage, due to the method of mounting.**
- **Grate and fuel bed load is not carried on chain and sprockets.**
- **Hoffman C-A-D grates may be installed to discharge at either front or rear.**



- **Unique air entry through the lower strand.**
- **Uniform air pressures under all parts of upper strand.**
- **Positive air seals, both front and rear . . . that work.**
- **Effective air seals between grate bar sections.**
- **Minimum heat conductivity from fuel bed to carriage.**

Ready to Ship

ENGINEERING COMPANY

OFFICES: Marquette Building, Detroit, Mich. Bell Building, Chicago, Illinois
154 Nassau Street, New York City Twenty-Two Marietta Bldg., Atlanta, Ga.

then he said to himself:

Either you eat . . . or you don't

The new Food Minister of Great Britain, Evelyn John St. Loe Strachey, highlighted a brilliant speech in the House of Commons with:

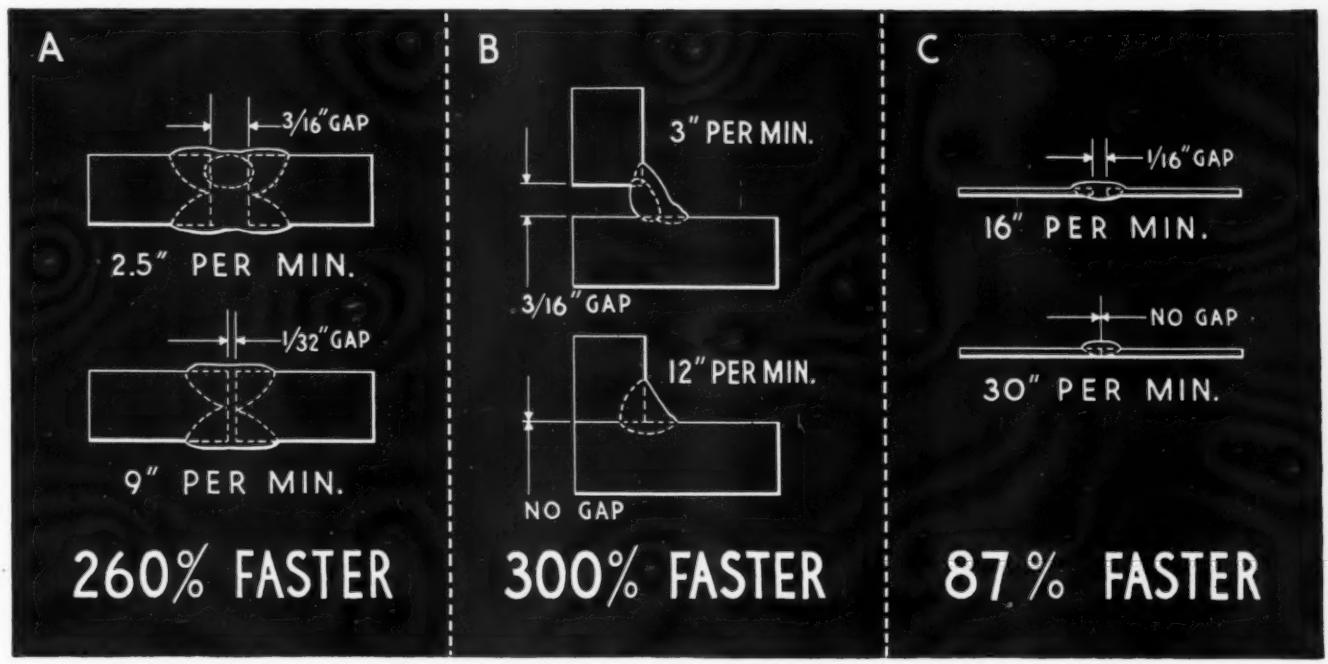
"Famine, like peace, is indivisible."

He was talking about famine but his phrase aptly applies to many conditions . . . particularly to the condition of modern production.

Either you compete
. . . or you don't.

MR. STRACHEY: **Here's food for thought to help you get the full measure of competitive advantage from arc welding:**

GET GOOD FIT-UP



Care in cutting, forming and fitting up of plates and shapes to be welded pays big dividends. By improving fit-up of joints, you increase welding speed and thereby cut costs and minimize distortion.

EXAMPLE A—This square butt joint in 3/8" plate with gap of 3/16" is made at an arc speed of 2.5" per min. With recommended gap of 1/32", speed is 9" per min.... 260% faster.

EXAMPLE B—This fillet weld in 1/2" plate, with 3/16" gap, is made at an arc speed of 3" per min. With no gap, speed is 12" per min.... 300% faster. Both welds have a 5/16" throat.

EXAMPLE C—This butt joint in 14 ga. sheet, with 1/16" gap, is made at an arc speed of 16" per min. With no gap, speed is 30" per min.... 87% faster.

The sign of abundance. When you see 3 DOTS on an electrode, you know you have genuine "Fleetweld" ... the world's leader for *low cost, speed* and *quality*. "Fleetweld" incorporates the full measure of Lincoln's pioneering research and worldwide engineering experience.

Handy pocket manual, giving, "Fleet-Welding" procedures for all types of joints in mild steel, free on request. Ask for Bul. 444.

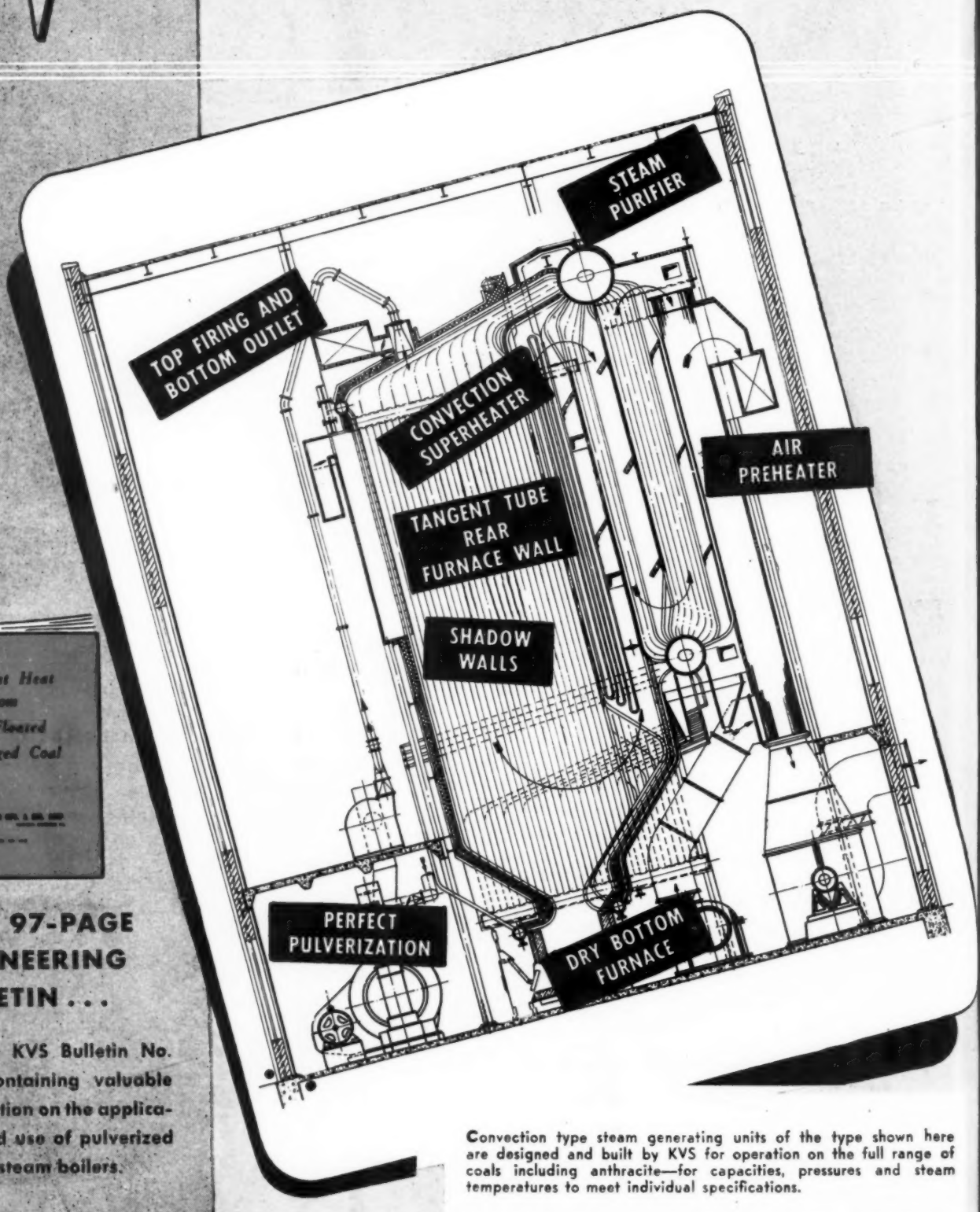
THE LINCOLN ELECTRIC COMPANY • DEPT. 433 • CLEVELAND 1, OHIO

America's greatest natural **recourse**

ARC WELDING

KVS

STEAM GENERATING PERFORMANCE-



Convection type steam generating units of the type shown here are designed and built by KVS for operation on the full range of coals including anthracite—for capacities, pressures and steam temperatures to meet individual specifications.

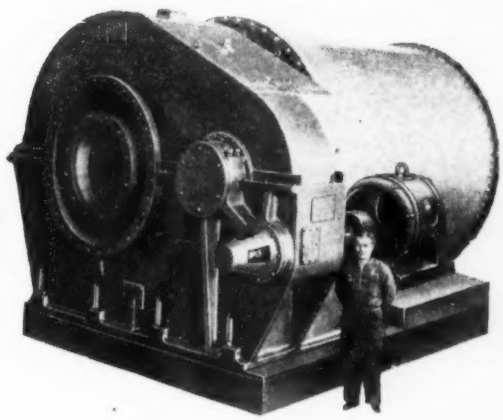
NEW 97-PAGE ENGINEERING BULLETIN . . .

Ask for KVS Bulletin No. 44-B containing valuable information on the application and use of pulverized coal to steam boilers.

EQUIPMENT . . . . . HAS BEEN PROVED *for Efficiency..and Low Cost Operation*

PERFECT PULVERIZATION

With the KVS Integral Drive Air Swept Tube Mill perfect pulverization is controlled by air separation. This unit assures proper preparation and carburization of all grades of coal at low cost for power and maintenance.



TOP FIRING AND BOTTOM OUTLET

In this design, better combustion control is provided because it is not necessary to "fight" the coal being burned. Even distribution of radiant heat is attained over furnace area. Through the use of the KVS Pulverizer, by which proper coal preparation is assured, and with the bottom outlet, complete control of carbon loss is achieved.

STEAM PURIFIER

The KVS Steam Purifier assures a highly effective means of purifying steam. Less than one-half of one part per million of impurities is carried over.

CONVECTION SUPERHEATER

In this steam generator the KVS Superheater is damper controlled and so designed as to attain final steam temperatures over the entire operating range.

TANGENT TUBE REAR FURNACE WALL

This design reduces refractory to absolute minimum and affords greater back surface area, minimizing soot or slag accumulation.

SHADOW WALLS

Increased heat absorbing surface is provided by KVS Shadow Walls, assuring a clean furnace and avoiding refractory maintenance.

AIR PREHEATER

This component is of compact design and is included in the boiler structure itself.

DRY BOTTOM FURNACE

Concentration of heat is eliminated in this feature of KVS design and tube failures thereby minimized.

KVS ENGINEERING

KVS Steam Generating Equipment has been performance-proved over the years. KVS offers a complete service in design, building and erecting complete plants under one responsibility. KVS engineers are available for consultation on your requirements.

KENNEDY-VAN SAUN · QUALITY · Kennedy Products · SERVICE · NEW YORK USA · MFG. & ENG. CORP.

Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

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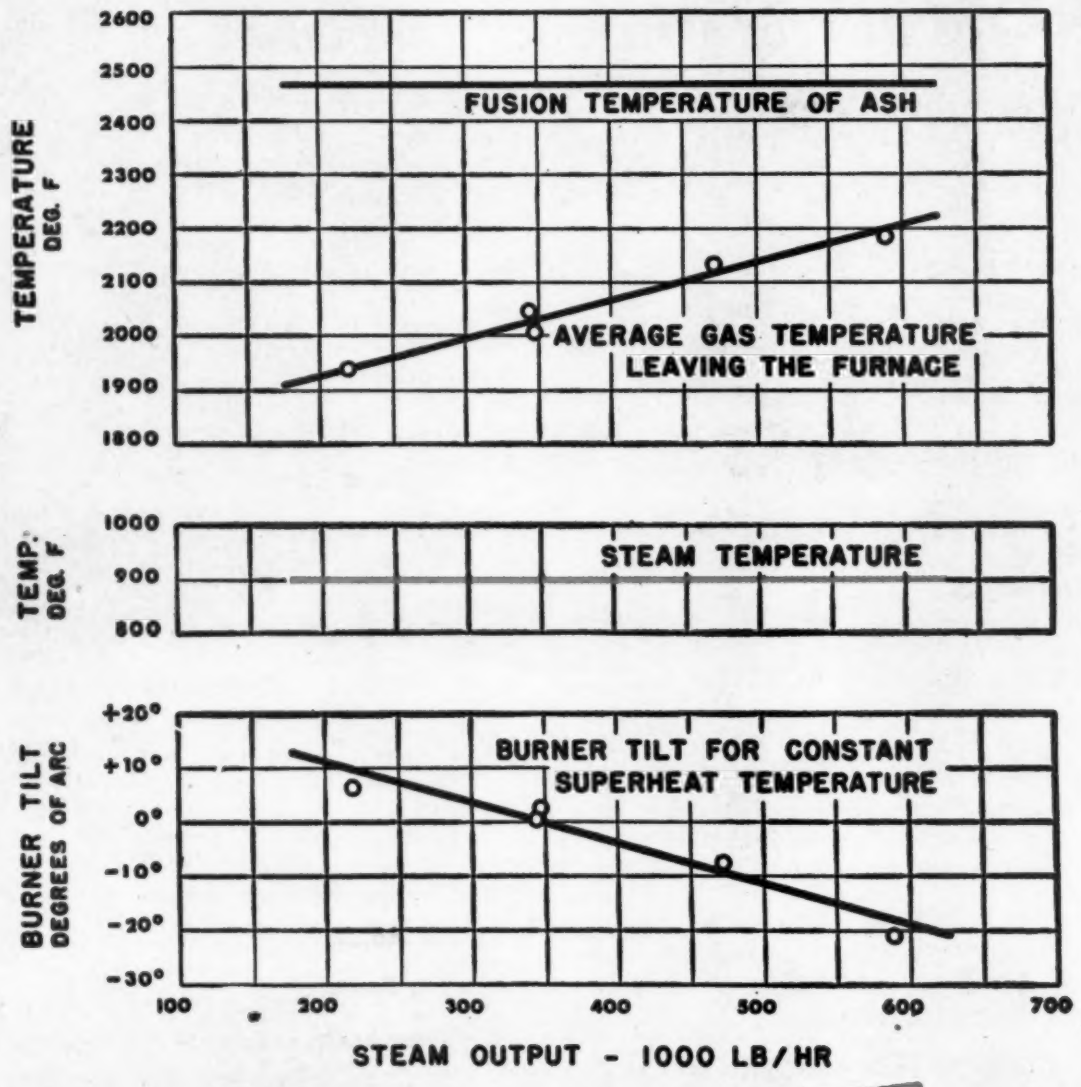
Furnace Temperature



This chart was plotted from data obtained through a series of exhaustive tests recently conducted at Plant Atkinson of the Georgia Power Company. Although the C-E Steam Generating Unit under test was equipped with a bypass damper for close control of final superheat temperatures, these results are obtainable by means of burner adjustment alone. Under routine operation, however, the bypass damper may be counted upon to provide the final "vernier" control.

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

Control...

THE REAL ANSWER TO CONSTANT SUPERHEAT

The Adjustable Furnace

The key to the Adjustable Furnace is vertically-adjustable tangential burners. By regulating the adjustable nozzles through an arc of 30 deg above and below the horizontal, the operator controls the position of the zone of turbulent combustion, thereby varying the effectiveness of the furnace wall areas. Thus the temperatures of the furnace gases entering the first boiler pass and superheater are under control.

Two important advantages are achieved: (1) control of furnace heat absorption and therefore furnace temperatures, and (2) wide range control of superheat temperature.

TODAY'S most difficult problem in the design of a high pressure, high temperature steam generating unit is *temperature control.*

It is not difficult to design a unit to deliver superheated steam of proper temperature at *one* load point and for a *given* fuel. But virtually every steam generating unit must be designed for variable load conditions — many for a wide range of capacities — and most units must be designed for variable fuel quality as well.

The answer is *furnace temperature control,* i.e. the ability to regulate, at will, the temperature of furnace gases as they enter the superheating surfaces. There is only one known way to accomplish this effectively — Tangential Firing with Vertically Adjustable Burners which provides, in effect, an Adjustable Furnace.

The panel at the left briefly describes how the Adjustable Furnace operates to achieve furnace temperature control. Confirmation of its effectiveness is shown by the chart of test results appearing on the opposite page.

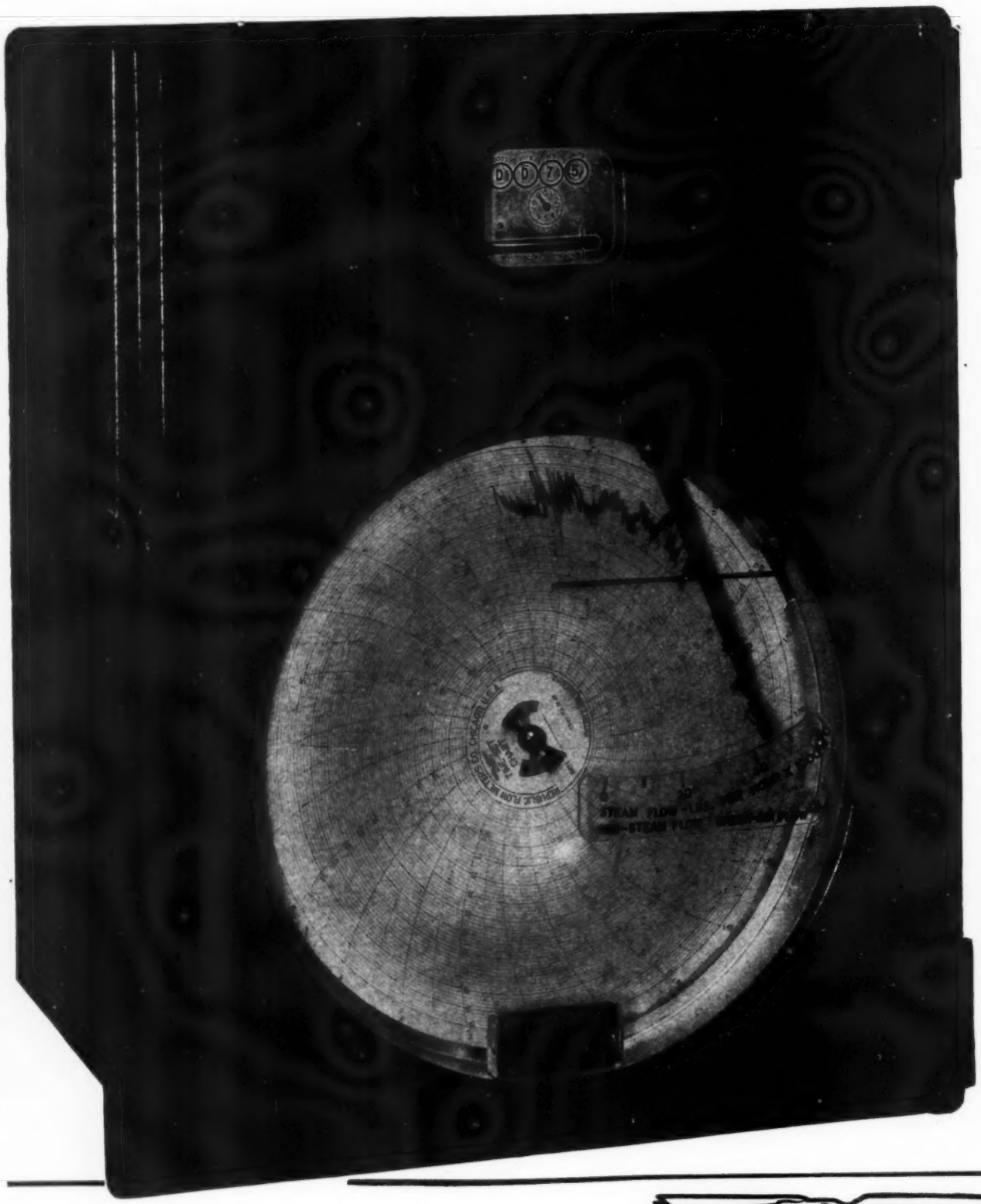
A-993

C-E

ENGINEERING

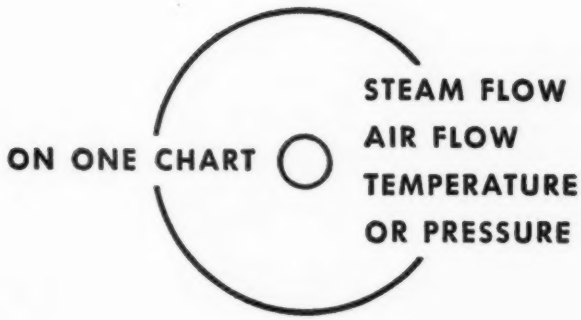
200 MADISON AVENUE NEW YORK 16, N. Y.

Write for Data on the



REPUBLIC
INSTRUMENTS
AND CONTROLS

Republic Boiler Meter



● The new Republic Boiler Meter provides, in one instrument and on one chart, all the essential information concerning boiler performance regardless of the size or type of boiler, kind of fuel or method of firing.

The meter indicates, records, and integrates steam flow from the boiler and records rate of air flow for combustion. When the correct amount of air for maximum combustion efficiency is being supplied the air flow pen will record coincident with the steam flow pen, regardless of the load being carried by the boiler.

A third pen recording flue gas temperature (or steam pressure) can be added thereby providing the operator with complete information, on one 12-inch chart, relative to the performance of the boiler at any given time.

The Republic Boiler Meter is primarily a boiler operating guide. The two records, steam flow in red and relative air flow in blue, tell the operator instantly whether correct combustion and furnace conditions exist, thereby enabling him to correct faulty conditions when they occur.

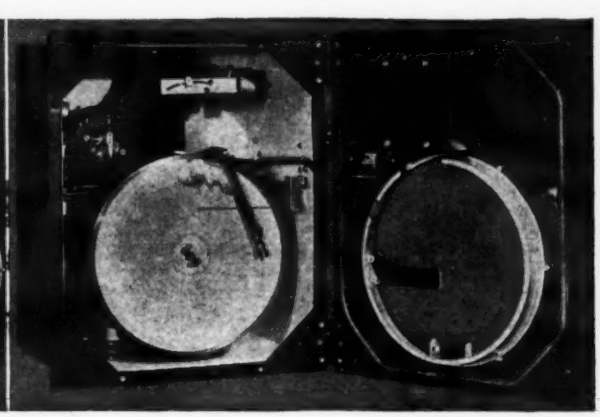
The Republic Boiler Meter consists of a standard Republic electric steam flow recorder and integrator and an oil sealed, bell type air flow element.

The air flow element consists of an oil sealed bell in a sealed chamber. The motion of the bell is transmitted through a diaphragm seal. This arrangement permits the use of a single bell—the high pressure being applied to the top of the bell and the low pressure under the bell. This arrangement also excludes air and dirt from the oil. The motion of the bell is transmitted to a cam system which extracts the square root, or when adjusted for a particular installation, compensates for chimney action and variable excess air requirements. The air flow pen is attached to the cam system with an adjustable linkage which permits changing the steam flow air flow ratio as conditions may require.

The entire operating mechanism is housed in a rugged steel case and can be easily removed as a single unit by merely loosening two anchor bolts and disconnecting the two air connections. The meter may be either wall mounted or flush mounted on a steel panel. *Write for Bulletin No. 420.*

Meter assembled as one unit on rack ready for calibration.

Meter assembly can be easily removed from the case.



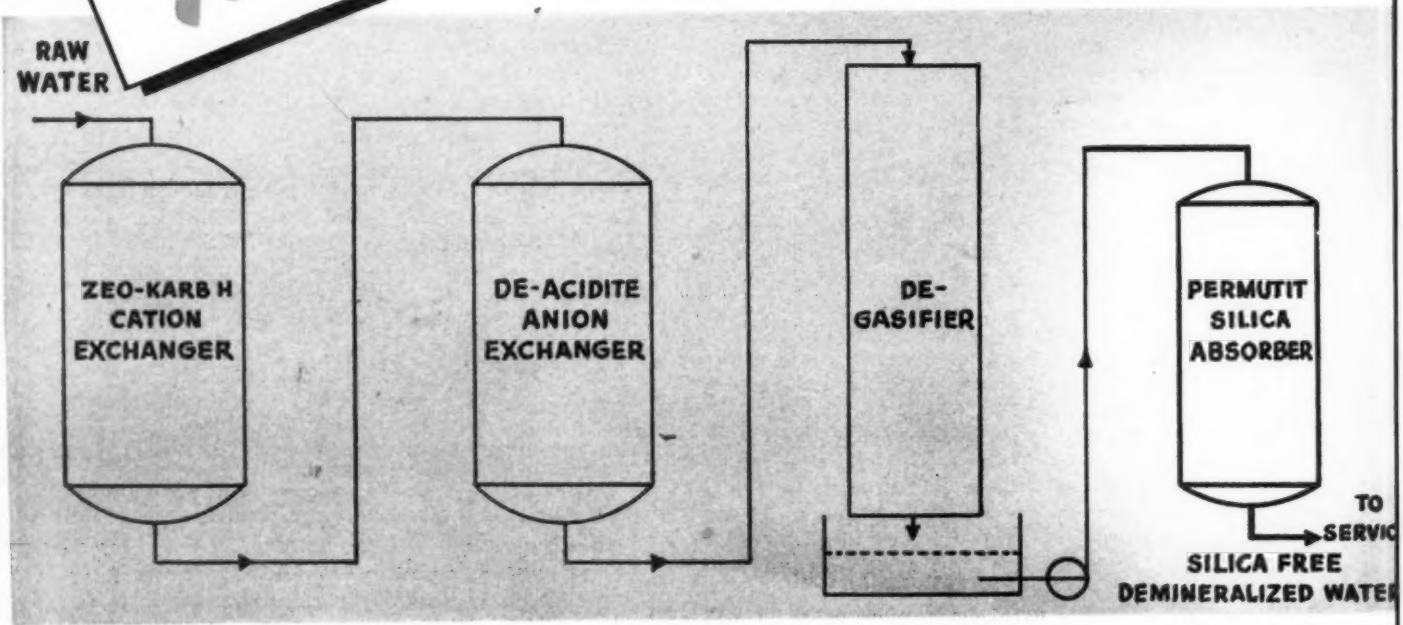
Meter with door open showing accessibility of all adjustments and working parts.

Republic Flow Meters Co.

2222 Diversey Parkway • Chicago 47, Illinois

TWO REVOLUTIONARY

1. SILICA REMOVAL *combined with* DEMINERALIZATION!



HERE'S AN ECONOMICAL NEW CHEMICAL PROCESS FOR PRODUCING THE EQUIVALENT OF DISTILLED WATER!

The Permutit* two-step De-mineralizing process utilizes Zeo-Karb H, Permutit's acid-regenerated cation exchanger to replace metallic cations with hydrogen ions, converting salts present into corresponding acids. These acids are then removed from solution by De-Acidite, Permutit's resinous anion exchanger.

NOW, for the first time, Permutit has added to the De-mineralizing process, a new, one-step, cold process silica removal treatment which removes silica down to a fraction of 1 p.p.m. — making possible ideal, silica-free, de-mineralized boiler-feed make up!

For information about this revolutionary new, low first cost, low operating cost treatment, address The Permutit Company, Dep't P-10, 330 West 42nd Street, New York 18, N. Y., or Permutit Company of Canada, Ltd., Montreal.

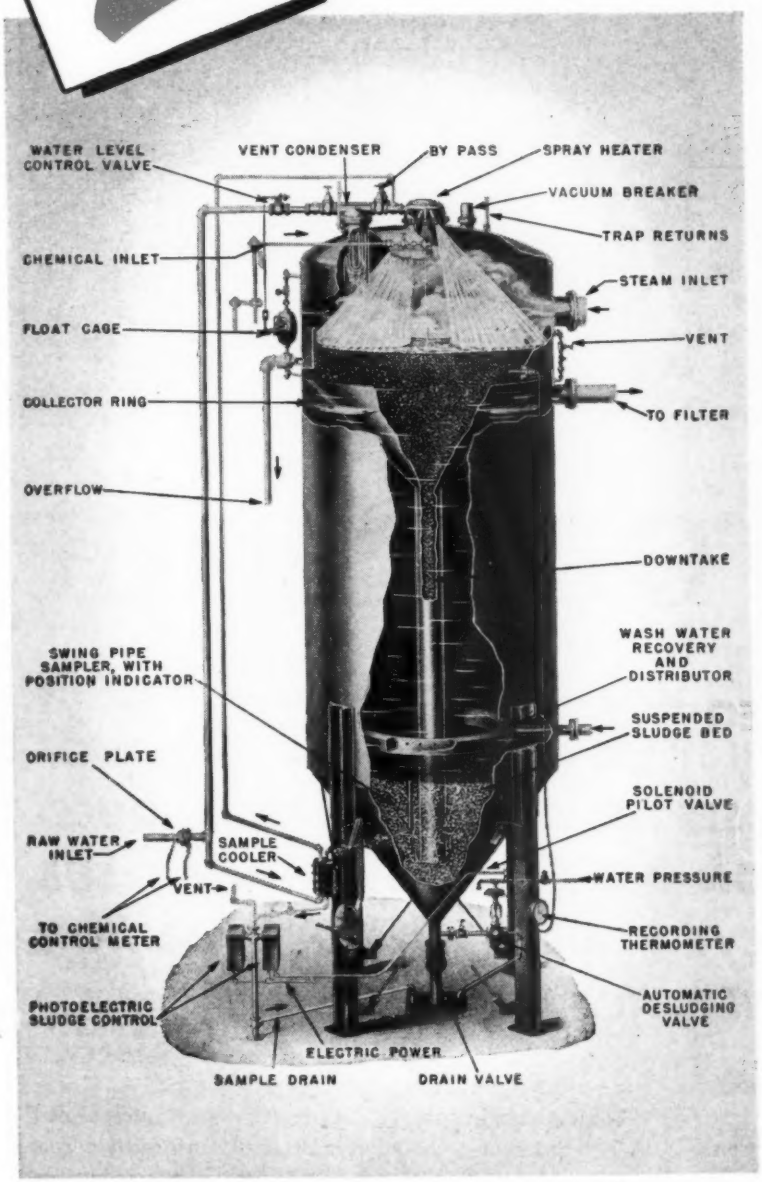
Permutit Pioneers Again!

WATER

The Permutit Company

NEW DEVELOPMENTS!

2. SLUDGE BLANKET HOT PROCESS!



GREATER ECONOMY IN CHEMICAL COST... GREATER EFFICIENCY IN REMOVAL!

The Permutit* Sludge Blanket Hot Process reduces turbidity of softened water, lessens the load on filters, reduces back-washing and lowers the amount of silica left in the water.

Low turbidity, a feature of this new Sludge Blanket design, effects considerable chemical savings because of its low consumption of expensive phosphate reagent. In addition, the new process reduces the amount of lime required, since unconsumed lime is retained in the blanket until it reacts with water hardness.

A higher degree of silica removal is possible with this new model because each particle has an intimate, prolonged contact with silica-absorbing magnesia.

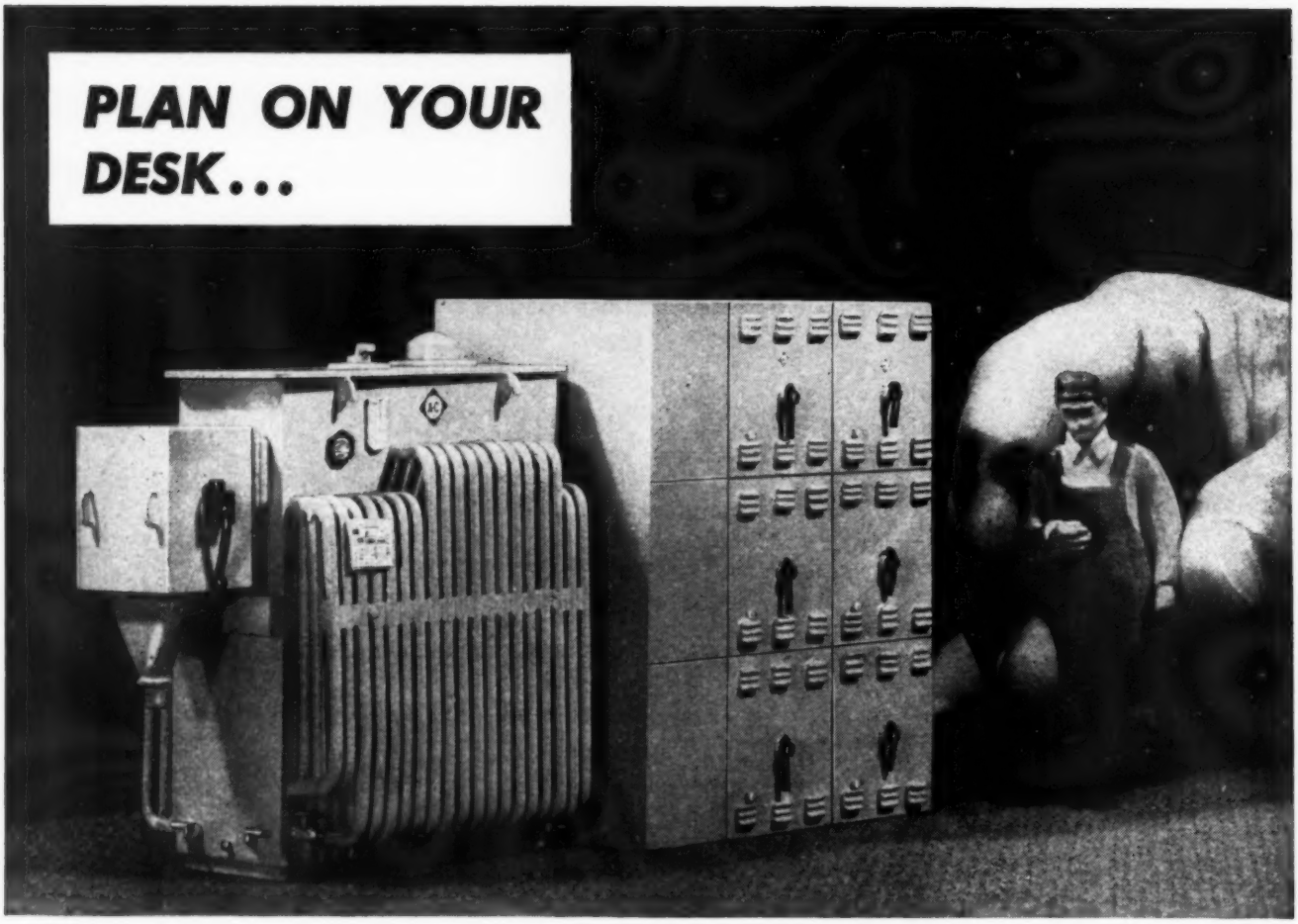
The depth of the sludge bed is controlled by an automatically-operated desludging valve actuated by a photoelectric turbidity detector. This detector automatically checks a continuous water sample and maintains turbidity at the desired value.

Write today for free, informative bulletin.

Trademark Reg. U. S. Pat. Of.

CONDITIONING HEADQUARTERS

330 West 42nd Street, New York 18, N. Y., or Permutit Company of Canada, Ltd., Montreal



Buy From Sight,

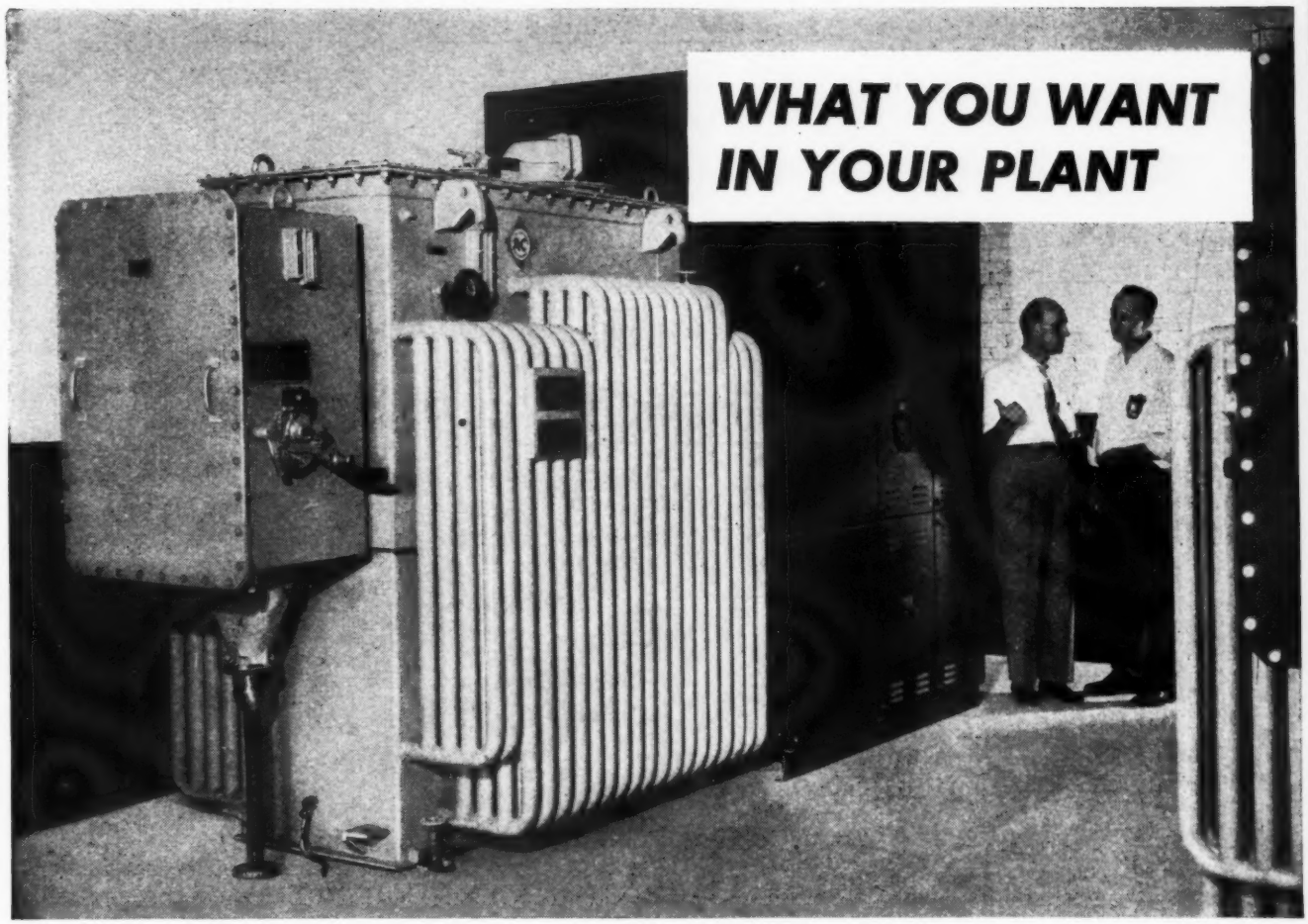
WHAT WILL MY UNIT SUB LOOK LIKE? WILL IT FIT IN THE SPACE THAT'S AVAILABLE? DO I HAVE A CHOICE OF ARRANGEMENTS? — YOU'LL SEE THE ANSWER TO THESE QUESTIONS WHEN YOU CALL ON ALLIS-CHALMERS' "UNIT SUB BUILDER" SET TO HELP SOLVE YOUR POWER DISTRIBUTION PROBLEMS... QUICKLY, EASILY, ACCURATELY!

ALL POSSIBLE substation arrangements are at your finger tips when you use Allis-Chalmers' "Unit Sub Builder" Set to help you plan the *right* power distribution system for your plant.

Accurate scale models of Allis-Chalmers Prefabricated Load Center Unit Substation apparatus make it possible for you to plan *visually, effortlessly.* You see what's available, how the various units combine to give you the last word in flexibility. You see results on your desk top.

What's more important: A-C models — accurately scaled ½ inch to 1 foot — are good insurance against costly power distribution planning mistakes. They make it possible for you to *pre-test* your unit sub ideas . . . let you see just what you're getting in terms of dimensions, characteristics, appearance.

You'll get an even clearer picture if models are built up



and Buy Right!

on a floor plan of your plant drawn to the same scale.

All the elements making up Allis-Chalmers unit substation equipment are contained — in miniature — in the model kit. In addition, there's a "Unit Sub Slide Rule" to simplify breaker calculation, and a valuable "Unit Sub Check List" to give you the added planning safety of a *double-check*.

Planners Like Service

In the comparatively short period Allis-Chalmers' "Unit Sub Builder" Set has been available for assisting power distribution planners, engineers of many leading U. S. firms have taken advantage of its time-saving, trouble-saving benefits. They like the idea of working out solutions . . . without bogging down in complicated charts and catalogues.

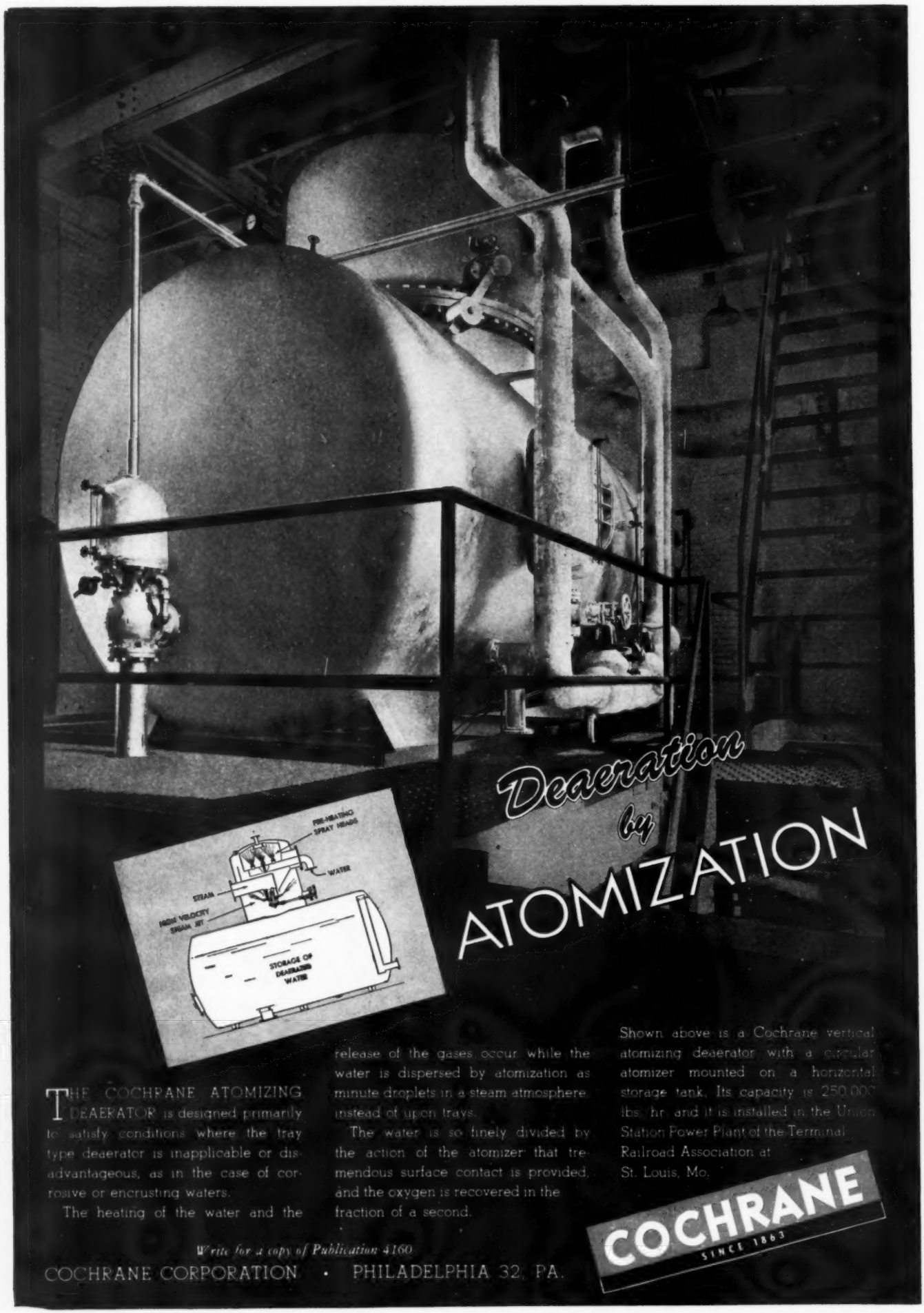
This complete *and proven* service is yours with no obligation. To see for yourself how the models, check list, and slide rule can help you in the planning of your power distribution system, call your nearby Allis-Chalmers district office for a showing. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WISCONSIN.

A 1950

—with

ALLIS-CHALMERS

Unit Sub Builder Set



Deaeration by ATOMIZATION

THE COCHRANE ATOMIZING DEAERATOR is designed primarily to satisfy conditions where the tray type deaerator is inapplicable or disadvantageous, as in the case of corrosive or encrusting waters.

The heating of the water and the release of the gases occur while the water is dispersed by atomization as minute droplets in a steam atmosphere instead of upon trays.

The water is so finely divided by the action of the atomizer that tremendous surface contact is provided, and the oxygen is recovered in the fraction of a second.

Shown above is a Cochrane vertical atomizing deaerator with a circular atomizer mounted on a horizontal storage tank. Its capacity is 250,000 lbs. hr. and it is installed in the Union Station Power Plant of the Terminal Railroad Association at St. Louis, Mo.

COCHRANE SINCE 1863

Write for a copy of Publication 4160

COCHRANE CORPORATION • PHILADELPHIA 32, PA.

ORES OR ROCK ✓
GLASS CULLET ✓
HOT SLAG ✓
FOUNDRY SAND ✓
COAL OR COKE ✓
METAL TURNINGS ✓
CHEMICALS ✓
WOOD CHIPS ✓
FULLER'S EARTH ✓
FOOD PRODUCTS ✓

What's YOUR haulage problem?

WE HAVE THE BELT to handle it!

No matter what kind of material you're hauling, there's a Goodyear conveyor belt that's made for you.

Built in a wide variety of types and sizes, Goodyear belts can be supplied with covers specially compounded to meet any operating hazard — abrasion, oil, acids, heat, heavy loads — or any other condition that's tough on belting.

Moreover, as the blueprint shows you, there are four sound structural reasons for Goodyear superiority, reasons that explain why, year after year, more tons are hauled on Goodyear conveyor belts than on any other kind.

If you want low-cost, super-efficient transport, why not call the G.T.M. — Goodyear Technical Man. He will be glad to recommend a belt exactly suited to your needs. To bring him to your office, write: Goodyear, Akron 16, Ohio or Los Angeles 54, California, or your nearest Goodyear Industrial Rubber Products Distributor, headquarters for hose, belting, molded goods and packing built to the world's highest quality standard.

Goodyear Style M Conveyor Belt for handling hot coke from wharf.

ONLY GOODYEAR CONVEYOR BELTS GIVE YOU THESE 4 MONEY-SAVING ADVANTAGES

1. PROPER TROUGHING INDICES — insure correct idler contact
2. MILDEW-INHIBITED CARCASS — prevents mildew rot that ruins many belts
3. LONGER COVER LIFE — use of covers with high abrasive index plus "breaker" to increase cover-to-carcass adhesion insures maximum resistance to abrasion and stripping
4. HIGH FLEX LIFE — skim coating between plies with highest quality friction rubber triples flex life on small pulleys

GOODYEAR

THE GREATEST NAME IN RUBBER

"YARWAY BLOW-OFF VALVES *Started us using* *All* YARWAY BOILER TRIM"

YARWAY SEATLESS TANDEM BLOW-OFF VALVES

These are the valves that are standard in over 12,000 boiler plants on pressures up to 600 psi. Balanced sliding plunger type with non-clogging, straight-through flow. No seats to score, wear or leak. See Bulletin B-424 for pressures to 400 psi; Bulletin B-432 for higher pressures.

YARWAY UNIT TANDEM BLOW-OFF VALVES

For pressures to 2500 psi, this tandem is the favorite. Combining the famous Yarway Seatless valve and a specially-designed hard-seat valve in a single one-piece forged steel body, it provides the advantages of both designs—for blowing or for draining and sealing—in a compact, rugged unit. For complete description see Bulletin B-432.

IT'S the same story in plant after plant . . . Yarway Blow-Off Valves giving such satisfactory, trouble-free service that the plant engineer decides to adopt Yarway Water Columns and Gages and Yarway Remote Boiler Water Level Indicators.

This story makes good sense, too. For like the famous *Seatless* Blow-Off Valve, all Yarway boiler trim products have a sound engineering reason why they give better steam plant service.

Yarway research, carried on constantly in Yarway's own unique steam laboratory, is in large measure responsible for the pace-setting features of Yarway products . . . features that anticipate and meet new and changing trends in steam plant requirements.

Modern boilers are a major investment. For maximum protection, install Yarway boiler trim.

YARNALL-WARING COMPANY
100 MERMAID AVENUE, PHILADELPHIA 18, PA.

YARWAY HIGH PRESSURE WATER COLUMN

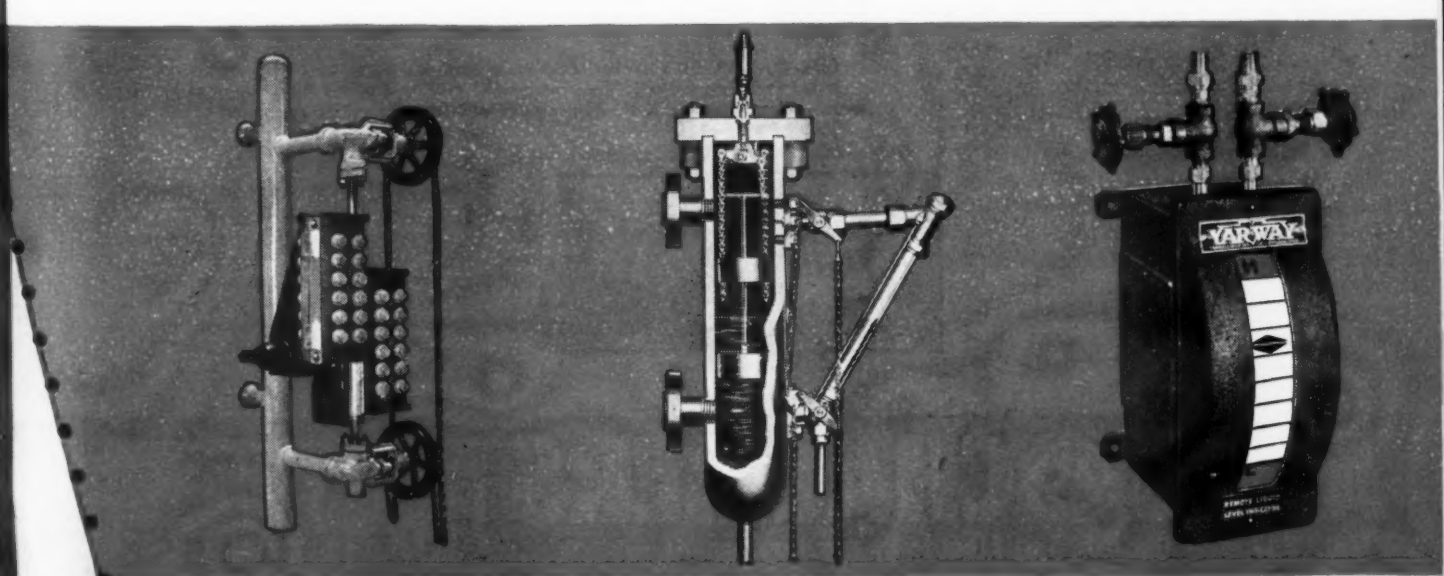
with welded GAGE VALVES AND FLAT GLASS GAGE . . . for 1550 psi. Improved design gives extra strength and dependability. Flat glass gage inserts are mica protected and have spring-loaded cover-plate cap screws and pressure-sealed gaskets which prevent excessive strain on glass. Described in Bulletin WG-1810.

YARWAY HI-LO ALARM WATER COLUMN WITH SESURE INCLINED GAGE

Alarm mechanism uses balanced solid weights and operates on the displacement principle to give instant, positive warning of dangerous changes from normal water level. For pressures to 400 psi. Described in Bulletin WG-1810.

YARWAY REMOTE BOILER WATER LEVEL INDICATOR

Brings hard-to-see overhead gage readings right down to eye level on instrument panel or other convenient place. Always positive because it's operated by the boiler water itself. Indicating mechanism is never under pressure. *There are no stuffing boxes.* Action is instant, constant and practically frictionless. Moderate in cost . . . easy to install. See Bulletin WG-1820.



YARWAY STEAM PLANT EQUIPMENT

WHEN A DIFFERENCE IN

Speed

MAKES A DIFFERENCE IN

Profit

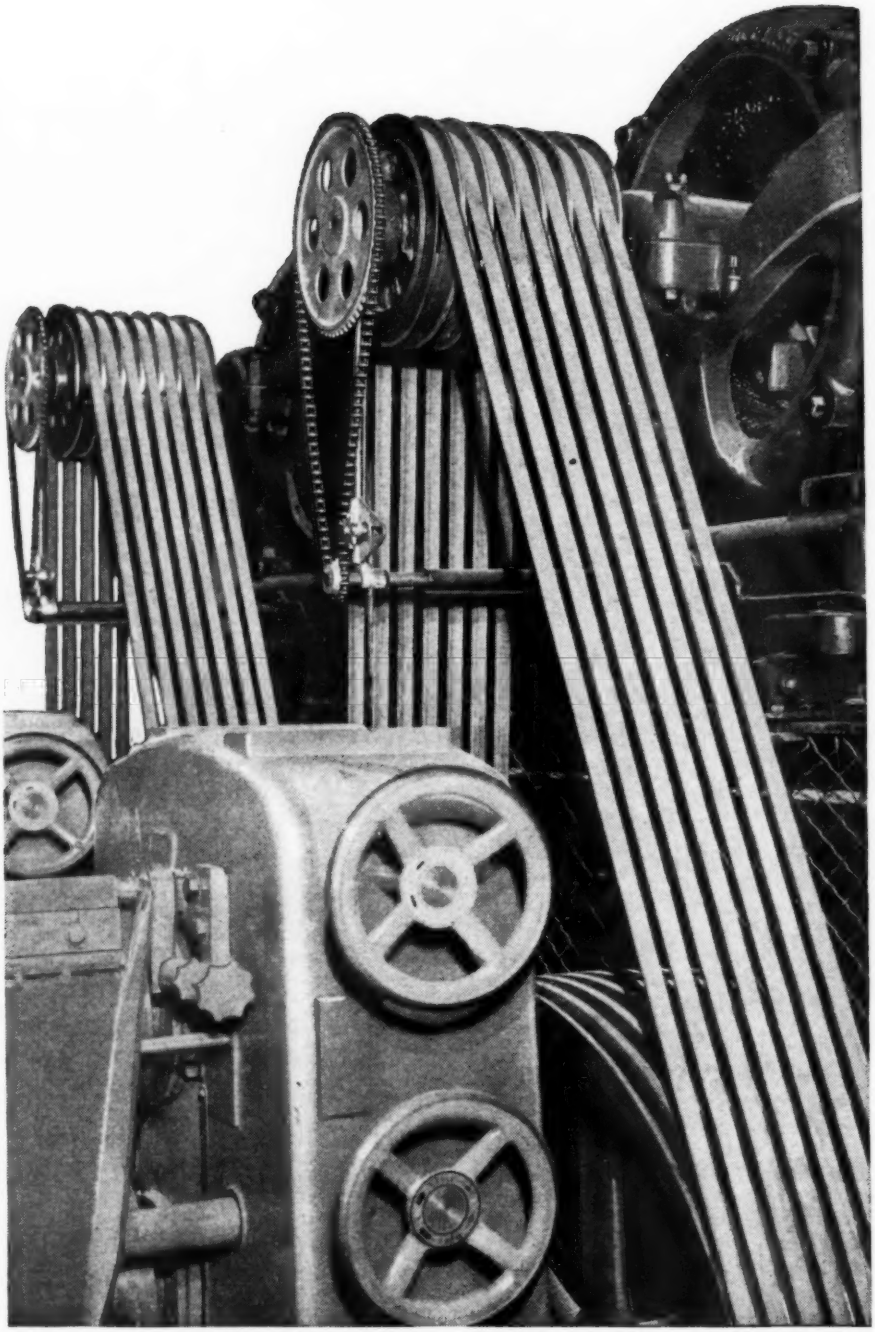
—When you can get greater efficiency, economy or output from a machine through flexible, accurate control of its operating speed — use a TEXROPE VARIABLE SPEED DRIVE! No special motor or costly reduction gears to install. In many cases, the only change required is to replace the regular drive sheave with a TEXROPE Vari-Pitch Sheave.

TEXROPE Variable Speed Drives

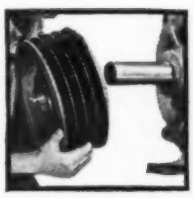
Here's a wide range of equipment to meet every need: TEXROPE Vari-Pitch sheaves for stationary or motion control — TEXROPE Wide-Range Vari-Pitch Sheaves and V-Belts — Speed Changer units. Speed variations up to 375% are possible. Ask your nearest Allis-Chalmers office or dealer for bulletin No. B6082-A.

V-Belt Drive Headquarters

Your A-C dealer has a full line of V-Belt Drive equipment—TEXROPE Super-7 V-Belts, sheaves and Variable Speed Drives. Get all your needs from one reliable source . . . from the originators of industry's Multiple V-Belt Drive. ALLIS-CHALMERS, MILWAUKEE 1, WIS.



(ABOVE) TEXROPE Vari-Pitch sheaves for motion control. They give smooth speed variations up to 25% on these roller mills used in the manufacture of soap chips. Changes in speed are made without stopping the machines.



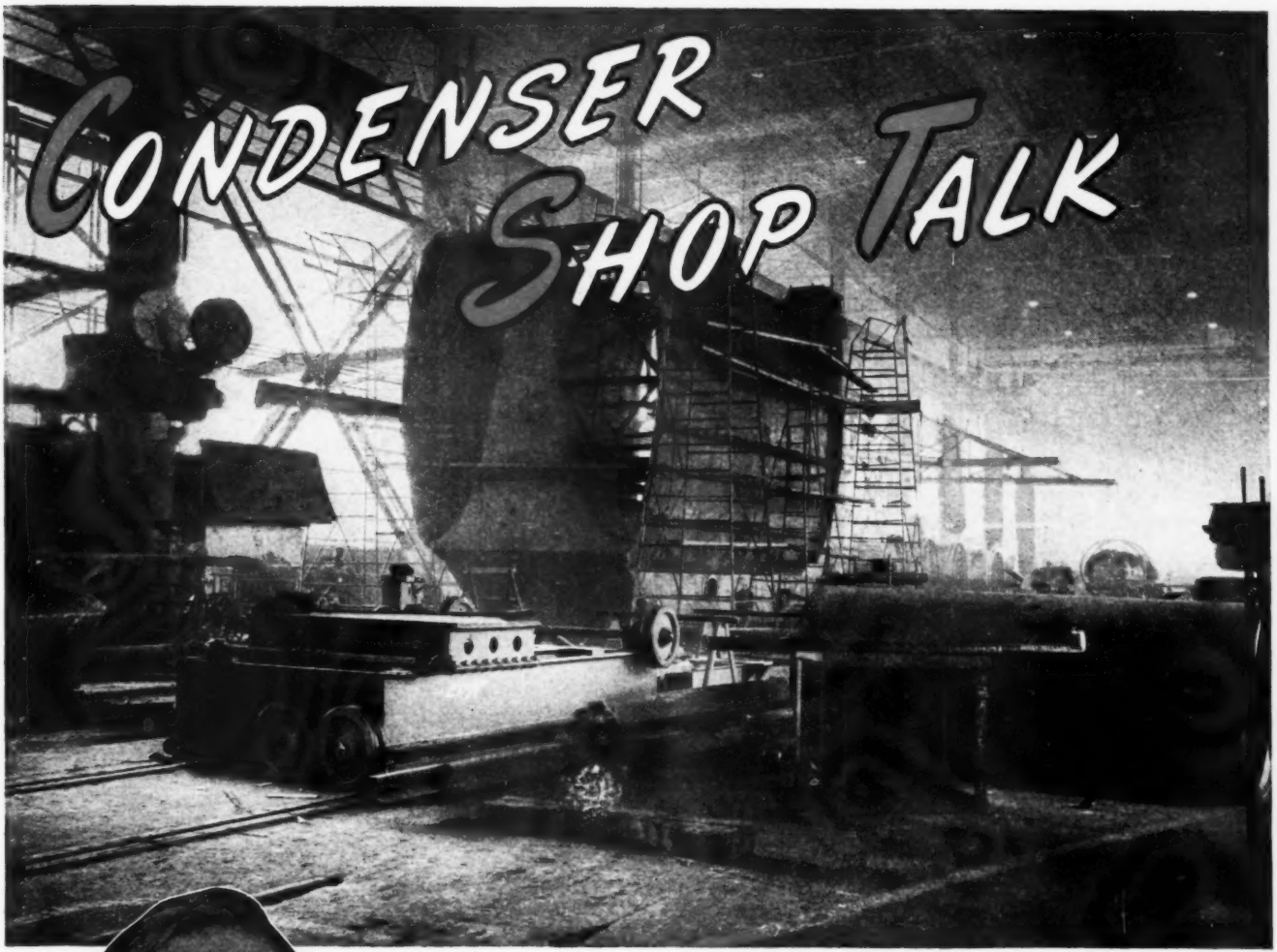
"MAGIC-GRIP" Sheave for fast changes

Here is the standard heavy-duty sheave for fast, easy mounting and demounting. *Sheave comes completely assembled.* Simply slip it on the shaft, move it to exact alignment, and tighten three cap screws. It's locked on the shaft with the grip of a vise — yet can be removed just as easily. No hammering, filing or reaming. No set screws to damage shaft. A2103

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

TEXROPE V-BELT DRIVES



A record of 42 years' exemplary service was achieved by Tom Farrington, Foster Wheeler employee, recently. He began work for Foster Wheeler in 1904.

TOM FARRINGTON SAYS:

"After 40 years I've just heard of two old friends and they are still in the best of health. Seriously, these friends are two FW condensers built in 1906, and I have an order for some minor repairs for them. I understand they are still doing a fine job."

The point is: the Foster Wheeler Repair Department receives orders for repairs to FW equipment installed over 40 years ago—and still going strong.

Often the men who built the equipment will direct the repair work. That's the service FW offers.

FOSTER WHEELER CORPORATION • 165 BROADWAY, NEW YORK 6, N. Y.

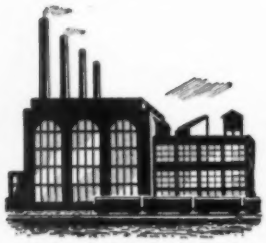
FOSTER WHEELER

A Wartime Development of Interest to Power Plant Men

The BADGER-KLEINSCHMIDT

VAPOR COMPRESSION

WATER STILL



POSSIBLE INDUSTRIAL APPLICATIONS INCLUDE USE TO PURIFY HIGH PRESSURE BOILER FEED WATER

American commanders of troops assaulting the Pacific islands never had to worry about water for their men.

Always at hand was an unlimited reservoir . . . *the sea.*

The link between the salty Pacific and pure drinking water was a distillation unit so efficient that a gallon of fresh water was obtained from the same heat input needed to bring a quart of water to the boil on a kitchen stove.

The unit was . . . ***the Badger-Kleinschmidt Vapor Compression Water Still,*** developed by Dr. R. V. Kleinschmidt of Arthur D. Little, Inc. and manufactured by E. B. Badger & Sons Co., Boston, Mass.

A major problem in designing the unit was the selection of materials. Combat use permitted a minimum of maintenance.

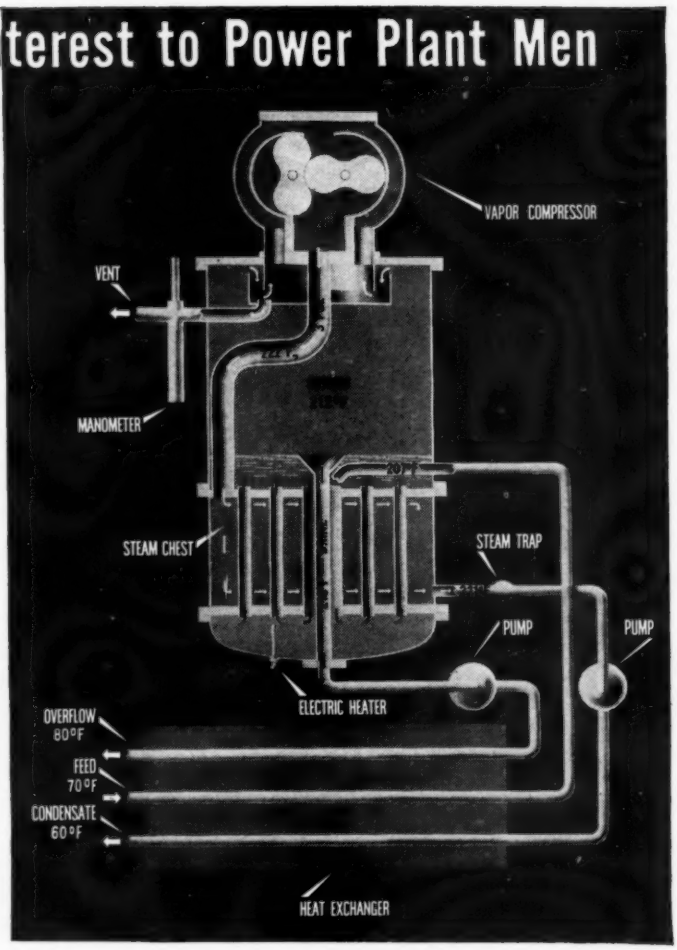
To counter the abrasive and corrosive conditions, nickel alloys were used throughout. For example, all sheet metal parts were made of a copper-nickel alloy. All nuts, bolts, studs, tie-rods, piping and other fittings were Monel.

With nickel alloys on the job it was no wonder that reports came back from the Pacific telling of Badger-Kleinschmidt stills operating smoothly even after their steel framework and housing had almost been completely eaten away.

That's why E. B. Badger & Sons Co. plans to continue using Monel in industrial vapor compression stills.

You always build-in EXTRA performance when you use nickel alloys for equipment to handle steam or water.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

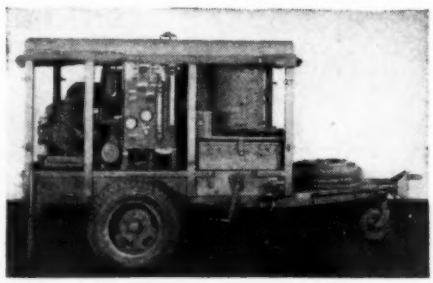


OPERATING PRINCIPLE

THE VAPOR COMPRESSION STILL'S conservation of heat is a close approach to perpetual motion. Feed water intake is through a heat exchanger. Sandwiched between concentric pipes carrying hot condensate and brine overflow, the feed water is raised to 207° F. Passing to the steam chest, it circulates through tubes surrounded by compressed steam at 222° F. This boils the water. The generated steam then goes to the compressor where it in turn is boosted to 222° F. Passing into the steam chest, it gives up most of its latent heat and boils new feed water. Then it passes through the heat exchanger and emerges as potable distillate.

In diesel-powered units, the exhaust supplies all the heat. In electric units, a separate electric heater is used. Thermal efficiency is 15 times that of ordinary single-phase stills.

TWO PUMPS are used on every B-K still. Many units are equipped with Warren SED vertical pumps. The SED, manufactured by WARREN STEAM PUMP CO., Warren, Mass., has a 1¼" Monel shaft and a "K" Monel shaft sleeve.



A PORTABLE B-K STILL used by the Army, Marines and Seabees. Fixed installations were aboard submarines and other Navy craft. E. B. BADGER & SONS CO. is ready to make stills up to capacities of 100,000 gallons per day. With these large-scale models available to economically distill high-pressure boiler feed water, boiler corrosion may well be licked.

NICKEL (INCO TRADE MARK) **ALLOYS** MONEL* · "K" MONEL* · "R" MONEL* · "KR" MONEL* · "S" MONEL* · INCONEL* · NICKEL · "L" NICKEL* · "Z" NICKEL*
*Reg. U. S. Pat. Off.

25 LONG-SCALE instruments in a 24" square

TYPES

AB-13—A-C

DB-13—D-C

VOLTMETERS
A-C & D-C

AMMETERS
A-C & D-C

WATTMETERS

VARMETERS

POWER-FACTOR METERS

SYNCHROSCOPES

FREQUENCY METERS

ALSO

Temperature Meters

Tachometers

concentrated *Readability*

Never before has it been possible to get so many switchboard instruments in such a small space—with an actual *increase* in readable accuracy. Only 4½-inches square, five of these compact, long-scale instruments can be mounted side-by-side on a 24-inch panel.

For the user—better instrumentation: Information on one or more circuits can be concentrated in a small area; many instruments can be read from one position; time can be saved in recording readings; and circuit data can be better correlated.

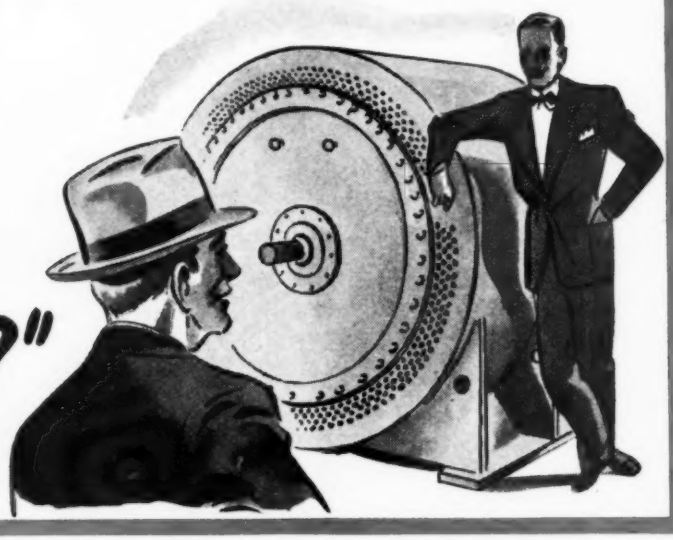
For the switchboard manufacturer—better panels: Valuable panel space can be more efficiently utilized; added economy in panel layout can be realized; and the size of the switchboard may even be reduced.

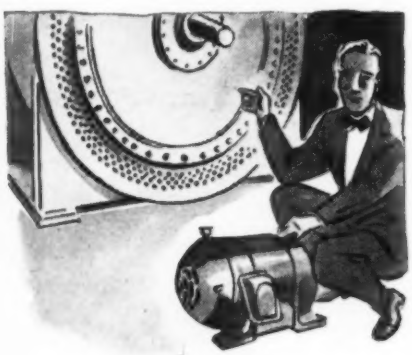
These factors, combined with the long 7-inch scale, 1 per-cent accuracy, greater sturdiness, and other high-quality features, mean benefits for you. Make it a point to call for G-E concentric-scale switchboard instruments on all future installations. Write for Bulletin GEA-3432. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

HEADQUARTERS FOR MEASUREMENTS

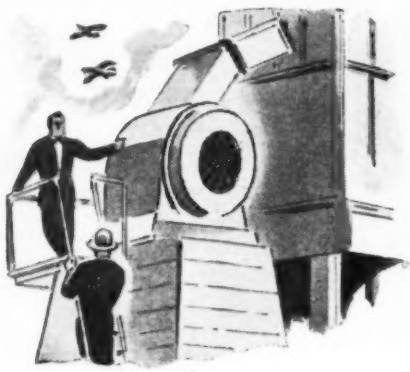
GENERAL ELECTRIC

"Did You Say, Up to 2000 hp ...Weatherproof?"

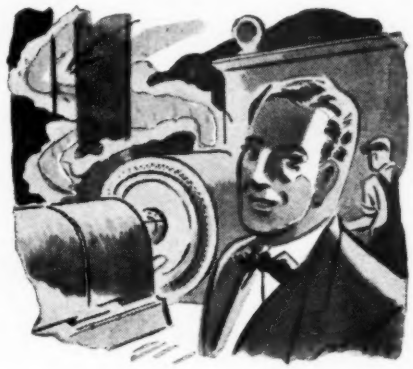




"Right. In Allis-Chalmers' modern motor line we're now prepared to offer you a *complete range* of outdoor weatherproof, totally-enclosed motors all the way from small, standard ratings to sizes of 2,000 hp or larger."



"Why, That Means Then," our customer exclaimed, "in larger ratings they fill the need of power plant engineers who want to install equipment like draft fans *outside*, and thus keep down structure costs per kw capacity." Right again —and they fit into *other* industries too!



Chemical, for instance. Here cast iron motors have generally been preferred . . . because they stand up better under acid and alkali conditions. But now these *new* motors, with *new* design improvements, promise to provide several important operating advantages . . .

We've Re-designed the heat-transfer system to *improve ventilation*. We've *reduced maintenance* by making air passages not only more accessible, but practically *self*-cleaning as well. And we've *eliminated* liquid and dirt-trapping pockets. In the smaller ratings we of course offer our standard design.

Looking for a Good Motor?

SPECIFY "Allis-Chalmers"! For whether your job calls for a large motor like that above, or a small standard machine, you can be sure of getting two things when you specify "Allis-Chalmers:" 1) Exactly the right type and size motor; 2) consistent with the finest quality workmanship of which we are capable.

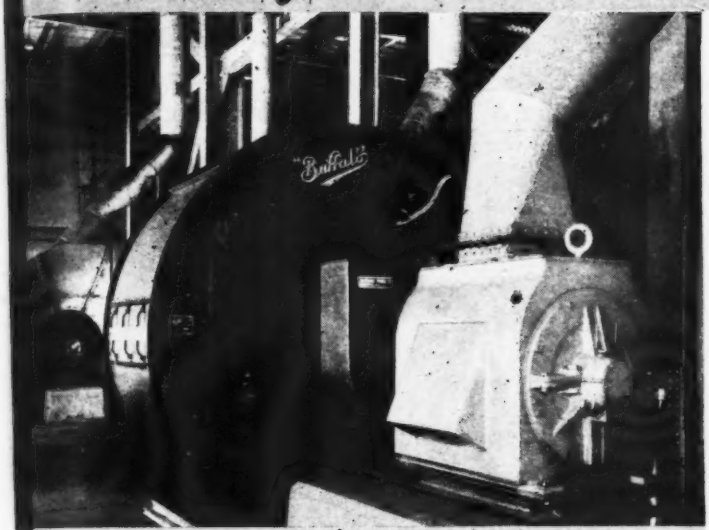
For the full story of liberal Allis-Chalmers motor construction, call our nearby dealer or sales office. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 2117

ALLIS-CHALMERS

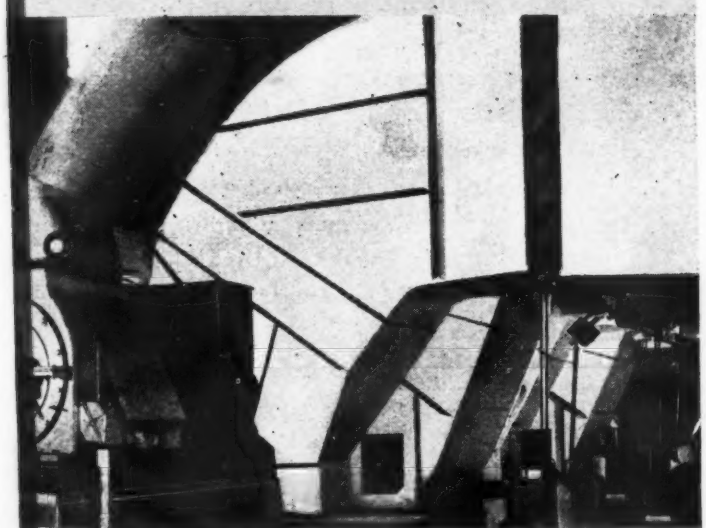
One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

STEAM AND KILOWATTS

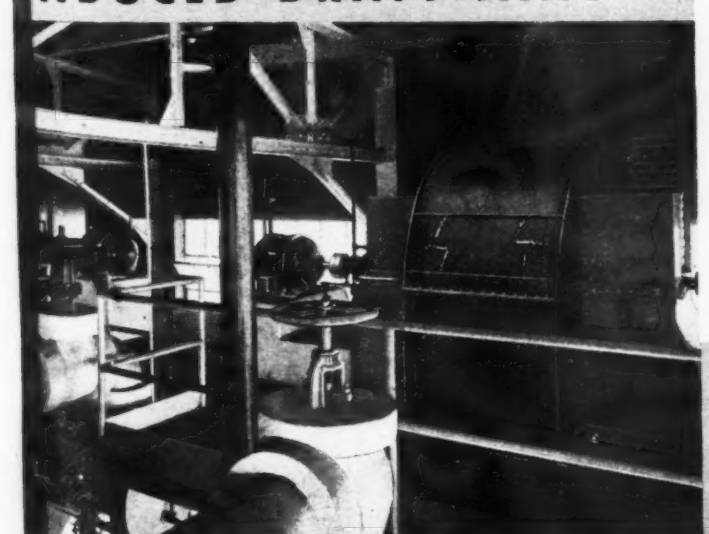
Keep 'em Coming



FORCED DRAFT FANS



NDUCED DRAFT FANS



NDER ELIMINATING FANS

WITH "Buffalo"

DRAFT FANS

Whether your operating responsibilities call for constant production of steam or electric power, you can rely on "Buffalo" Mechanical Draft Fans to carry out those responsibilities.

To handle tough boiler firing jobs on 24-hour-a-day schedules, "Buffalo" rotors and housings are *extra heavy* in design . . . shafts and bearings all oversize. And they've proven their ability to absorb punishment in hundreds of plants, both in the production-crammed war years and in peacetime operation.

As to maintenance replacements, these "Buffalo" fans feature readily removable housings, with all parts accessible! "Time-out" is at a minimum when erosion finally calls for a new part.

Why not investigate these fans that cut down on power-producing expense . . . as well as many of your power "headaches"? Simply write us for full details, or consult your "Buffalo" representative for recommendations.

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo" first for fans

DRAFT FANS

Dependable combustion control for small plants with the

Simplified

Hagan system

Small steam plants need an accurate, dependable, rugged automatic combustion control system at moderate cost.

Hundreds of such plants have found the answer in the Hagan *simplified* system, consisting essentially of a Hagan Master Regulator and one or more Hagan Furnace Draft Controllers. These are part of the regular line of Hagan equipment, meeting exactly the same standards of engineering and construction as the Hagan equipment used in the largest power plants. Reduction in cost is achieved by eliminating refinements in the Hagan system which are not essential in small plants.

These simplified Hagan Automatic Combustion Control systems have a long record of satisfactory service.

One mid-western industrial plant installed this equipment on its first two boilers, back in 1929. For 15 years the Master Regulator was in continuous operation except for a few week ends when it was shut down for repacking the cylinder. From time to time, additional boilers were connected to the system, but the same Master Regulator served all of them.

Finally, in 1944, still more boilers were added and the plant changed over to the Hagan panel type of control.

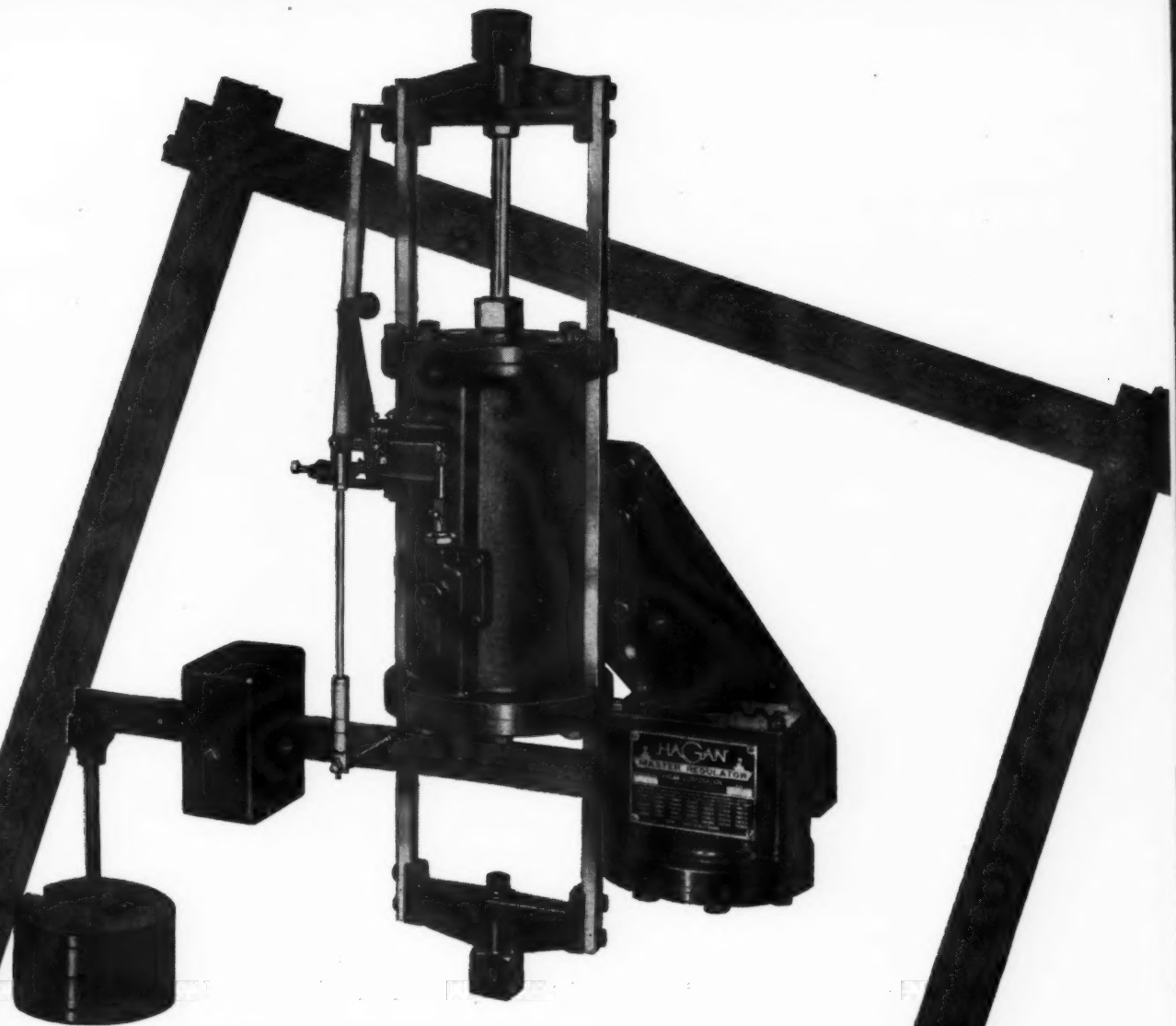
The Master Regulator was no longer needed—but its years of service were not ended. A nearby company needed a control system for an auxiliary boiler which operated at a lower pressure than the others and hence could not be linked to the existing control system. Sale to this company was arranged, and after repacking and fitting with new linkage pins, this 15-year-old Hagan Master Regulator was again at work—and is giving perfect service.

Our engineers will be glad to show you how the Hagan *simplified* automatic combustion control will cut your fuel costs. Write for full information.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.



All Hagan control systems are designed on the principle that *control* and *metering* are separate functions. Only when these functions are kept independent of each other can control equipment have the dependability, ruggedness, sensitivity and speed of response that are essential for the proper operation of Automatic Combustion Control systems.

HAGAN
HALL
BUROMIN
CALGON

Call Your Nearest

DIRECT
DELIVERY SERVICE

ENGINEERING
SERVICE

COMPLETE
STOCK ROOM
FACILITIES

AID IN SOLVING
OPERATING AND
MAINTENANCE PROBLEMS

Fig. 2125
Bronze Gate

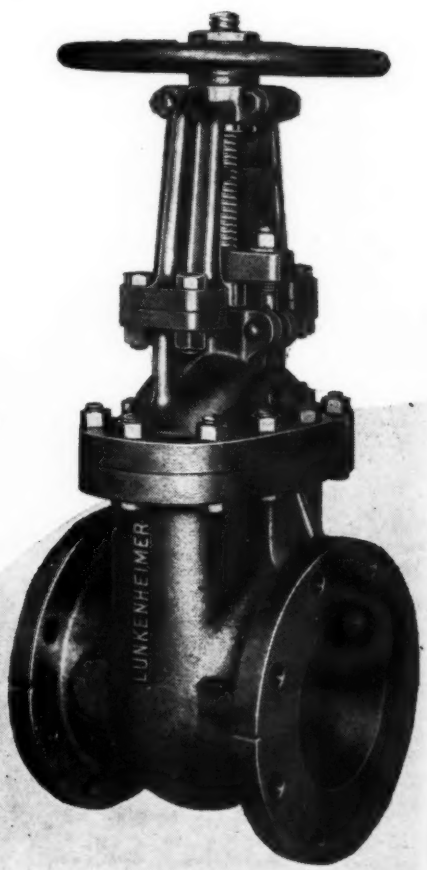


Fig. 1430
Iron Body Gate

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For production economy and efficiency, you must, of course, have good valves to begin with. That's why maintenance men prefer Lunkenheimer longer-life Valves . . . correctly engineered, quality built, dependable.

Yet in themselves even the best valves are not enough. A convenient source of supply and dependable service are equally important.

Lunkenheimer Distributors, located in principal industrial centers, render a complete valve service that saves time, trouble and money. Trained, qualified representatives are at your call to help with your valve problems.

For better, experienced valve service, call your nearest Lunkenheimer Distributor.

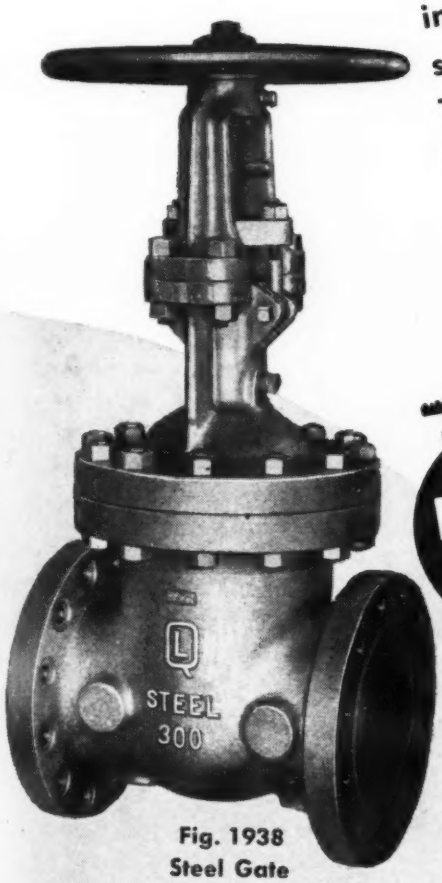

Fig. 1938
Steel Gate

• • •

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The new model E-32 EYE-HYE for pressures to 400 lbs.

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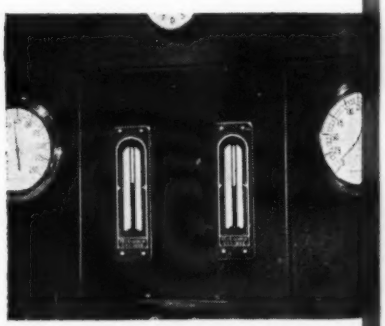
- Greater Pressure Range
- Modern Design

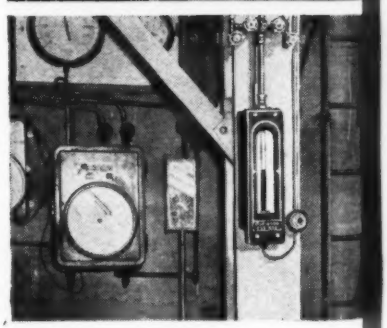
Reliance EYE-HYE now brings you more advantages than ever in accurate, dependable clear indication for remote water level supervision

● EYE-HYE reads like water gages you've always known—only it's close by, down at eye level. Sharp and clear, the illuminated green indicating fluid rises and falls in direct proportion to the conventional drum gage. You instantly *know* its meaning, like the familiar column of liquid in the gage above.

Easy to install, use and maintain, EYE-HYE brings water level reading where you want it—any reasonable distance from the drum—even *above* it if desired.

Its convenient placement on wall or panel board forces more frequent attention to water level performance—protects you and your power plant from the danger and expense of water level accidents.





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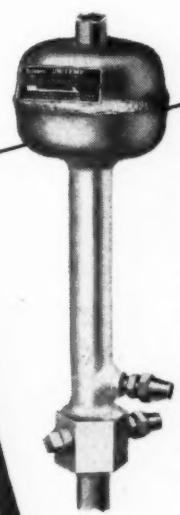
EYE-HYE, the Reliance all-hydrostatic remote reading gage, *couldn't be simpler in principle* . . . But improvements have been made in construction and design

● Model E-32 for pressures to 400 lbs. is now in production as the first of the restyled EYE-HYE line. Other new models, for pressure ranges to 2,000 lbs., will soon be ready. While no improvement can be made in its simple operating principle, several distinct advances have been made in construction. Restyled face plate provides a handsome instrument for either wall or panel mounting.

EYE-HYE is made entirely of bronze and forged steel—no cast iron parts • The new case is drip-proof—no water from above can reach the electrical connections (illuminator) • Arrangement of interior makes for easier access to illuminating lamp and tubular indicating glass • The window unit is shorter and narrower—a more compact unit • Diffused illumination effectively throws green indicating fluid into sharp relief, for easier reading • Calibration is fixed—cannot be tampered with in service.

The simplicity of EYE-HYE is the secret of its dependable accuracy — praised by thousands of engineers in both stationary and marine power plants. More than 7,000 EYE-HYEs have been put into actual service on pressures ranging from vacuum to 1,800 lbs. In most installations, EYE-HYE provides more accurate water level readings than the water glass on the water column. EYE-HYE is approved by leading power authorities and consulting engineers —is accepted in some codes as the *second* gage where two gages are required on higher pressures. Write for information.



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Correction for temperature variation is not left to chance with the EYE-HYE. The Unitemp is a special condensing reservoir which maintains an even temperature in both hydrostatic legs, thus assuring accuracy of EYE-HYE under all conditions—even greater accuracy than the ordinary water gage. It is furnished as original equipment with each EYE-HYE.

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Cleveland, Ohio

SUCCESS STORY....

THE other day, to satisfy our innate curiosity, we sat down and counted up the number of plants in which ALCO prefabricated pipe had been installed. The total was 316—*a success story in which some of the most prominent corporations and companies in the United States had a part.*

No one knows better than a plant manager, or a plant engineer, how widely varying are prefabricated pipe requirements. Though nearly every installation presented an entirely new problem, ALCO designed and built pipe which completely satisfied *every one* of these 316 good customers.

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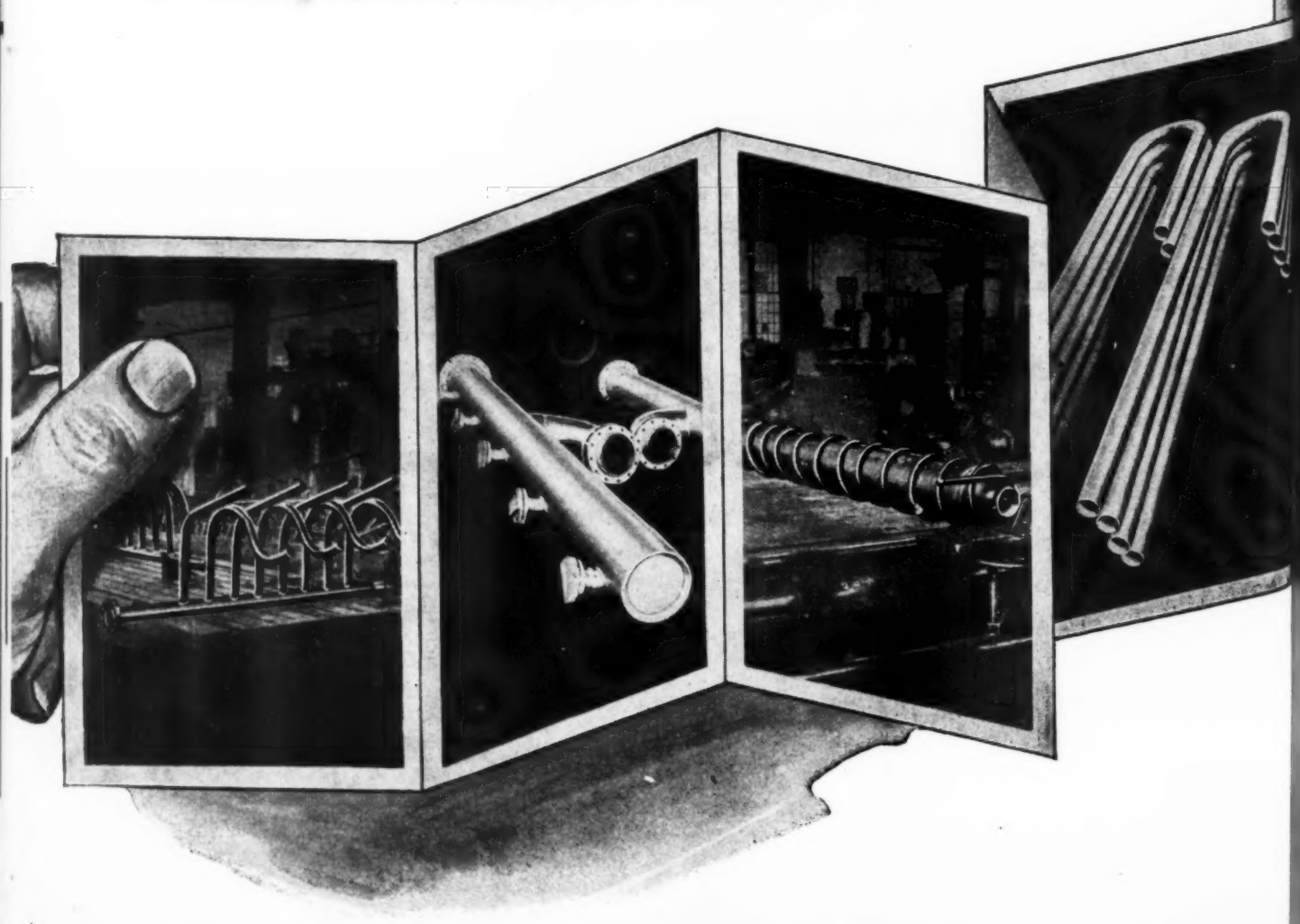
ALCO's competent, progressive engineering staff is at your beck and call. Let us assist you in your pipe problems. Perhaps *your* case history will be the *317th chapter* in a success story which has no ending. Address inquiries to the American Locomotive Company, Alco Products Division, 30 Church St., New York 8, New York.



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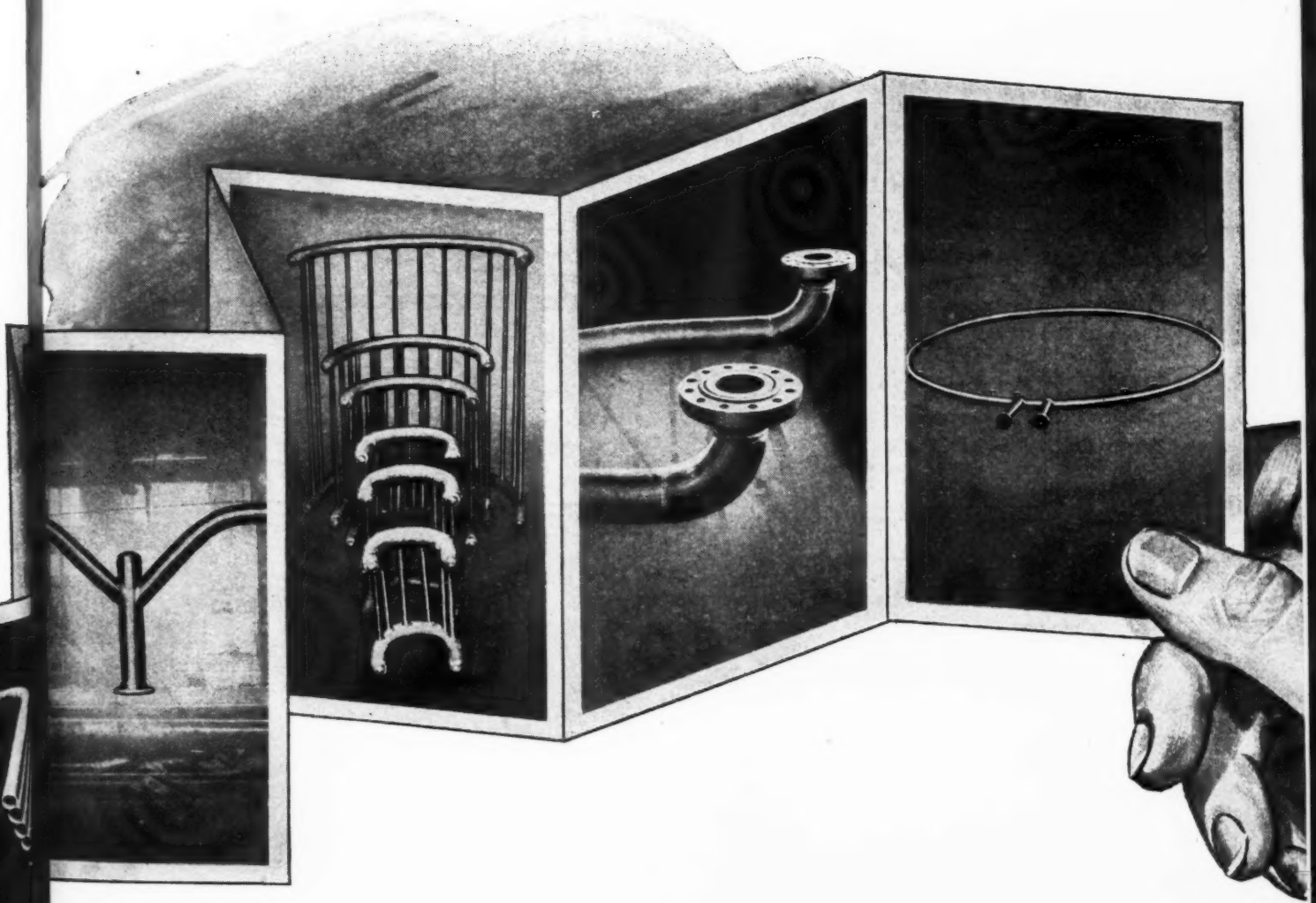

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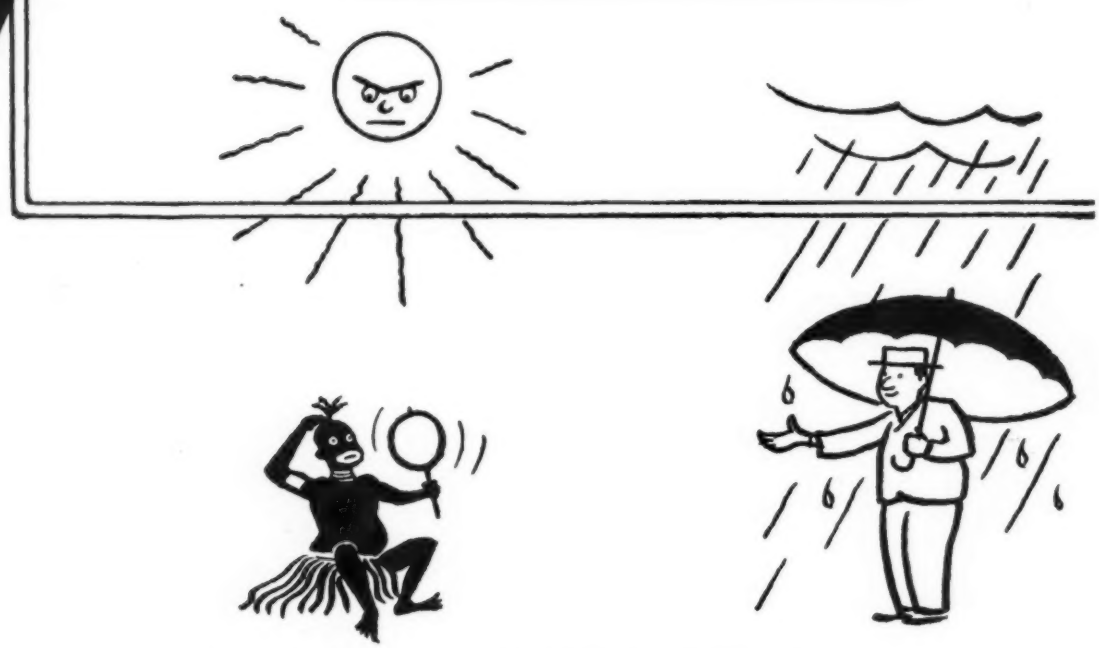

REMEMBER the toothpaste manufacturer who advertised, "We couldn't improve the cream, so we improved the tube"? Well, we never thought we could improve the quality of Taylor Accuratus Tubing. It featured a built-in compensation for temperature variations between the point of measurement and the instrument case. And this extended the many advantages of the mercury actuated system to applications requiring long lengths of connecting tubing.

But now we *have* improved it! From tip of bulb to instrument case Taylor Mercury Actuated Thermal Systems are standard with 18-8 stainless steel. It's better than ever before and gives you these new, extra advantages:

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2. Tougher. Withstands more bending and vibration.

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Great power and dependability. Recognized as the most universal measuring system of all available types, now that Taylor Accuratus Tubing has so greatly broadened its field of application.

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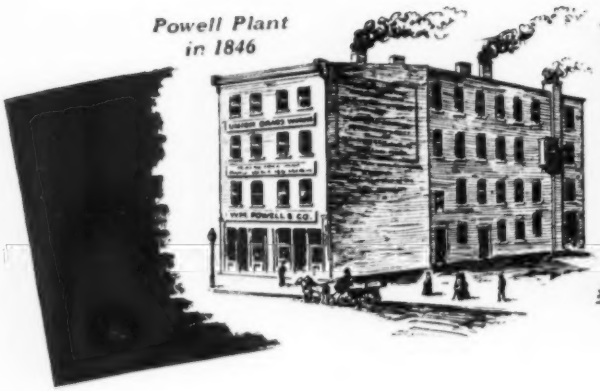


POWELL go a

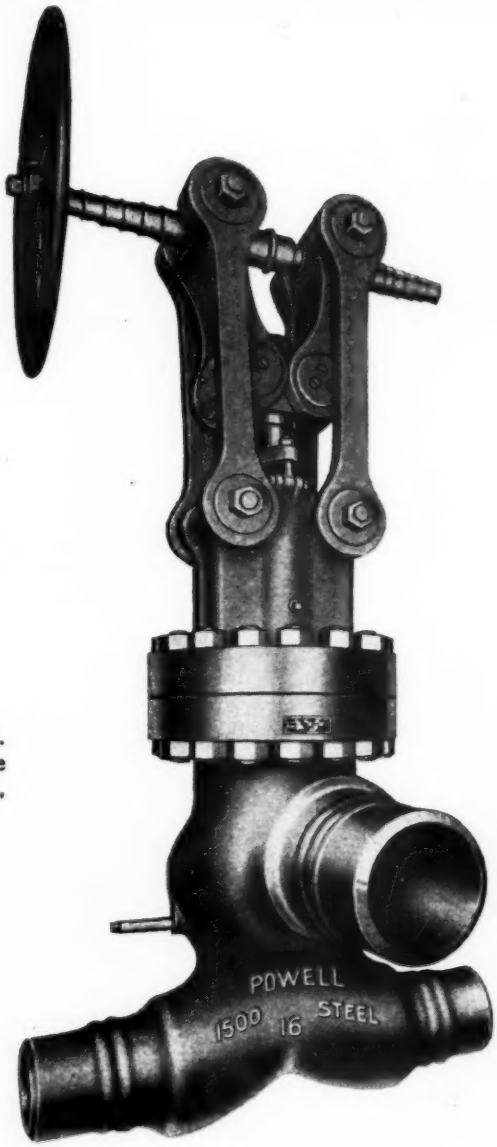
Powell Valves *have gone* a long way since the famous "Star" Regrinding Globe Valve was patented in 1865.

Today, with a notably complete line of valves, which includes every required type, size and design—in bronze, iron, steel and a wide range of pure metals and special alloys for corrosion resistance—Powell Valves *are going* a long way in meeting the flow control requirements of modern industry.

Best of all, Powell Valves always *go* a long way in actual service, because each valve is designed to give maximum performance under actual operating conditions it will meet.

Fig. 241—125-pound Iron Body Bronze Mounted Globe Valve. Has flanged ends, outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc. Also available in All Iron.

Catalogs furnished on request. Kindly state whether you are chiefly interested in Bronze, Iron, or Cast Steel Valves.



A Powell answer to the demand for higher pressure and higher temperature flow control equipment. This Class 1500-pound Cast Steel Non-return Angle Valve with welding ends, has a 16" outlet and two 12" inlets. Said to be one of the largest of its kind ever built. Because of its special streamline designing, the pressure drop through the valve is reduced to a minimum. Toggle operated.

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VALVES long way

Powell Plant Today

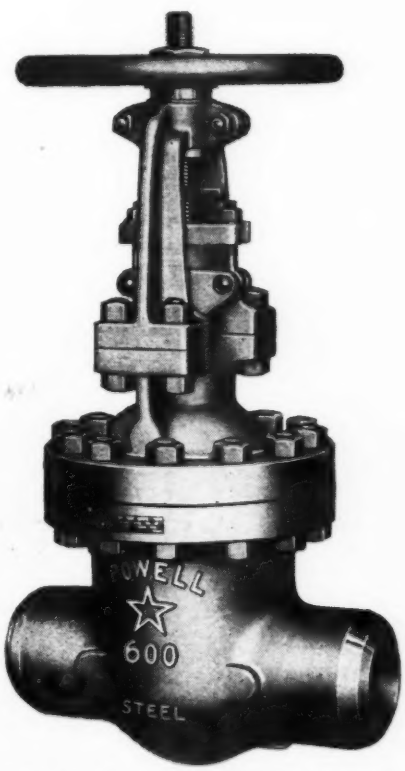


Fig. 6003 W. E.—Class 600-pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Powell Cast Steel Valves of all types are available in pressure classes from 150 to 2500 pounds, inclusive.

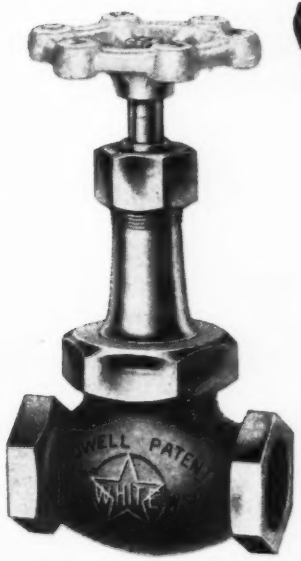
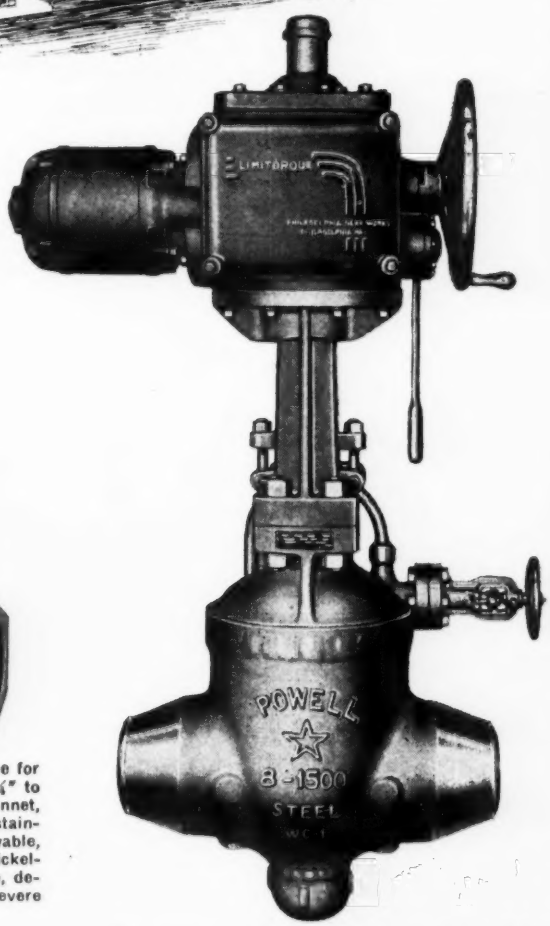
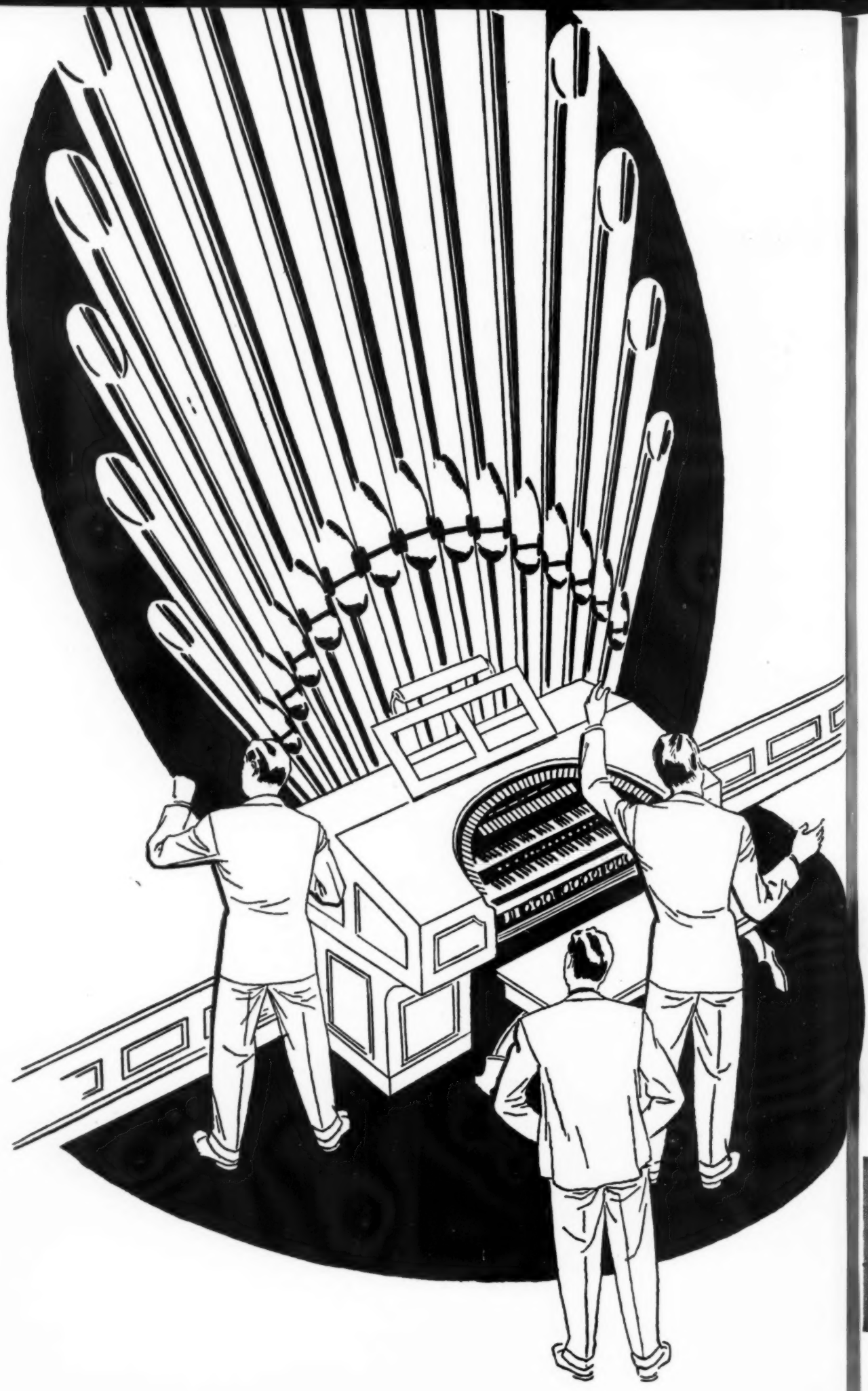


Fig. 1708—Small Bronze Globe Valve for 200 pounds W.S.P. Made in sizes ¼" to 3", incl. Has screwed ends, union bonnet, renewable, specially heat-treated stainless steel seat and regrindable, renewable, wear-resisting "Powellium" nickel-bronze disc. This is a long-life valve, designed to stand up under the most severe service conditions.



Class 1500 pound, 8-inch Cast Alloy Steel Gate Valve with welding ends, welded bonnet and special by-pass. Top-mounted electric motor operator provides quick, positive opening and closing by remote control.

VALVES



Pipe organ blues

for the plant engineer

The heating plant serving a group of buildings in a Pennsylvania city, was one of the most unlikely places to expect serious trouble. Yet trouble *did* occur several months after boiler water conditioning was started. More and more phosphate had to be used, and still the tests showed that the concentration in the boiler water was much too low.

A check-up indicated that the makeup water was satisfactorily low in hardness when it left the softener, so the only possible conclusion was that somehow there was raw water contamination of the condensate. The plant engineer didn't see how this could possibly happen, and there was certainly no such contamination at any point in the main building. Attention therefore turned to the other buildings.

The inspection started at the least likely spot—an auditorium. Nothing there, the plant engineer explained, but bare walls. Steam was used for heating only. When the Hall engineer admired the great pipe organ, his guide began to tell him about it—the musicians who had praised it, statistics about the number and size of the pipes and so on. An instrument of this size, he pointed out, had to be carefully treated. Humidity had to be just right, or the tones would not be true. In fact a special air conditioning system had been installed inside the organ, and was always turned on a short time before each concert.

That was all the cue the Hall engineer needed, and the plant engineer, too, got the idea his own words had suggested. Together they inspected the air conditioning system. They found first of all that it hadn't been turned off after the last concert held some two weeks before. Then they traced the piping—and found that the overflow which was, of course, untreated was discharging into the condensate return line, and thereby getting back to the boilers.

Tracing boiler water trouble to a pipe organ is unique—however, it is not unusual to find the source of trouble in work done by someone who failed to understand the connection between that work and the steam generating system. Our records show that time and again the troubles encountered in plants that have Hall service are due to factors other than water.

The ability of Hall engineers to trace and correct these troubles is one reason why *every plant that generates its own steam can profitably use Hall service.* We will be glad to send you full information.

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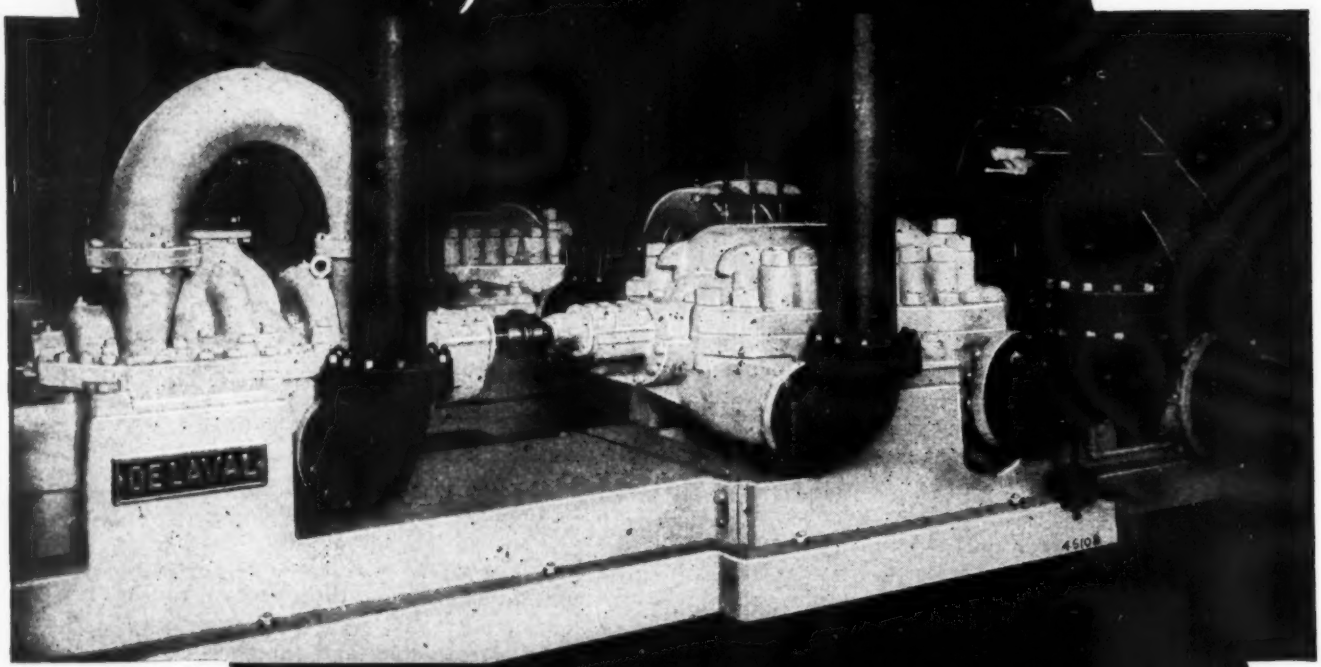
THE DEPENDABLE DRIVE *for* BOILER FEED PUMPS



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OCTOBER 1946 VOLUME 90, NUMBER 10

A CROSS-INDEX OF SUBJECTS FOR THE MONTH

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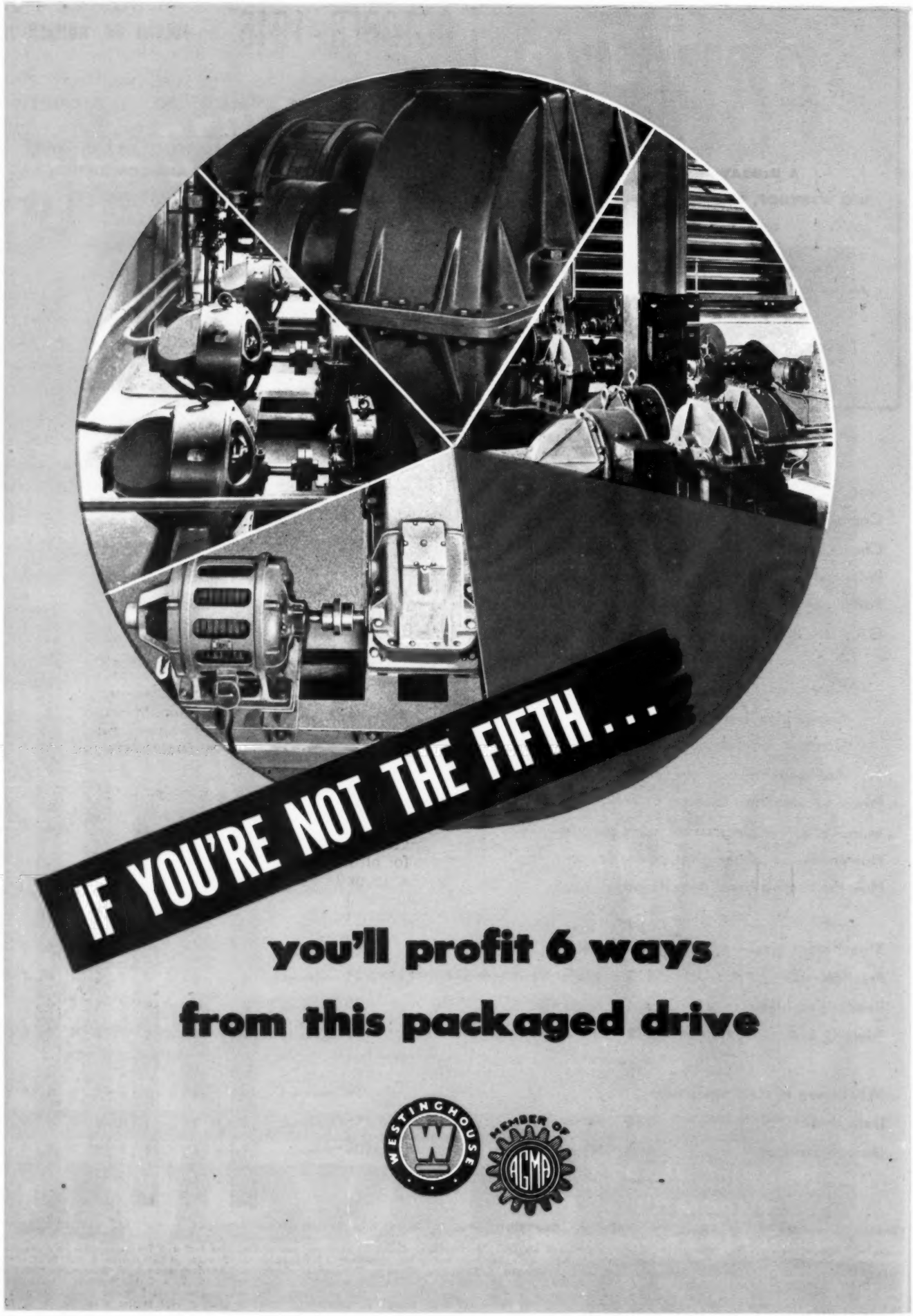
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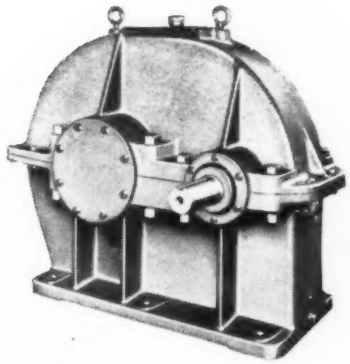

This Type SH speed reducer is a single-reduction unit which is furnished in thirteen standard ratios in each of twelve sizes. The Type DH speed reducer, which is a double-reduction unit, is offered in fifteen standard ratios in each of twelve sizes.

Because 4 out of 5 machines operate at slower speeds than their prime movers supply, you stand to gain six ways when you put Westinghouse speed reducers to work for you:

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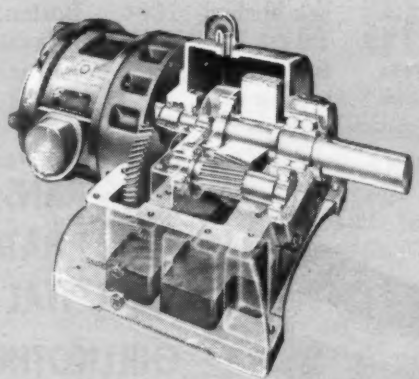

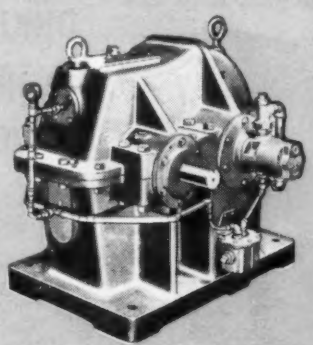

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This fact was recognized in selecting piping materials for the boiler house at the Veterans Administration Hospital, Chillicothe, Ohio. The feed water lines between feed water heater and suction pumps and between tank and heater; the boiler feed piping; the blow-off lines; the returns; the vents; and the cold water lines, were specified "wrought iron." Byers Wrought Iron Pipe was installed; some of the services are shown in the illustration.

Corrosion can always be anticipated in these applications; the only question is the degree of severity. Byers Wrought Iron has been used in all these services, and its superior corrosion-resistance is a matter of engineering record. Even when current corrosive conditions are not severe, far-sighted specifiers use wrought iron as insurance against possible changes in the character of the water in the future.

The excellent record of Byers Wrought Iron in corrosive services like these is due to its unusual structure and composition. Tiny fibers of glass-like silicate slag are threaded through a body of high-purity iron. These fibers act like baffles, halting and dispersing corrosive attack, and so discouraging the pitting and penetration that causes ordinary materials to fail. They also anchor the initial protective film, which shields the underlying metal.

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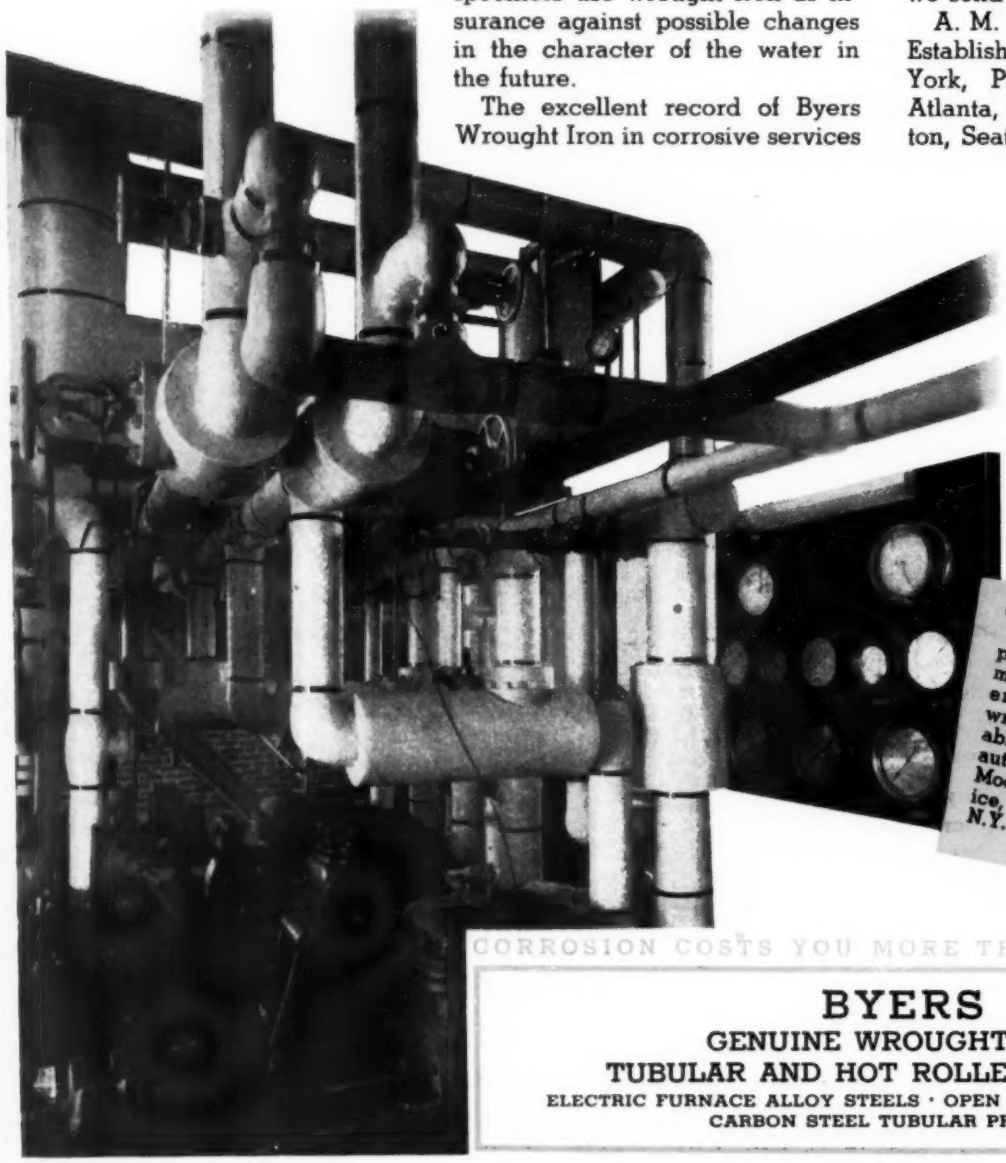

VETERANS ADMINISTRATION HOSPITAL

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POWER

PHILIP W SWAIN, EDITOR • OCTOBER 1946 • ESTABLISHED IN 1882

An Oldtimer Speaks

EARLY THIS YEAR C C POUNDER, an engineer designer of years and wisdom, addressed the students of the North East Institution of Engineers and Shipbuilders, Newcastle on Tyne, England. He told the boys about engineers and engineering. Here are quotes for all to ponder and remember:

"Once it is clear that engineers are not scientists—and conversely that scientists are certainly not engineers—many things take their proper place."

"Engineering is, first and last, a commercial business—Shoes are sold on suitability, durability, price and so on; so is a power plant—This may be obvious, but nevertheless it is hard to get technical men to appreciate the commercial aspect of their work."

"An engineer must have integrity—the begetter and basis of confidence—Considerable use may be made of the stupid men, of the maimed, the halt, the hesitant, and even the lazy, but nothing can be done with the untrustworthy man."

"With uprightness goes loyalty. Unobtrusive and inarticulate, it is the twin brother of confidence."

"Next comes sound judgment, including the ability to adjudicate correctly upon the manifold workaday problems; to appraise values; to sense trends; to analyze causes and prescribe remedies.—Sound judgment is bound up with common sense and with modesty. An erratic man cannot consistently exercise sound judgment; nor can an egotist."

"It is surprising how wholly devoid of common sense are many highly intelligent men.—There is a bond between common sense and a sense of humor.—The man of common sense can admit that he is wrong and gain strength by the admission."

"Intelligence, by itself, can be overrated. Not all of our leading men possess a high order of intelligence. Energy, willingness and industry speak for themselves; so do dependability and thoroughness. Here the normal man scores. Clever people are, too often, erratic and lopsided; when a man's talents rise to the genius level his instability frequently negatives the value of his gifts, both to himself and to others."

"It is extremely difficult to make a thing simple. Clever young men find this to be their hardest lesson. Many never learn it. Often have I brought down the iconoclastic hammer upon well-intentioned efforts, exuberant with gadgets, all worked out and proved to be correct. Anybody can devise a complicated mechanism, but it takes a master of his craft to produce something simple and sound."

"The engine and the machine are hard taskmasters. Lose or win; kill or cure; heaven or hell; the lawyer, the doctor, the cleric may receive their fees; but when things go wrong with the machine, the engineer's competence is quickly called in question."

"In recent years there has been a tendency for engineers to regard themselves as not being properly recognized in the life of the nation. It is quite true that they are not, but the fault is their own."

These are thoughts C C Pounder laid on the line to guide budding design engineers. They are good foundation stones for a sound career in any kind of engineering anywhere in the world.

Good Design, Proper Fabrication Make High-Temperature Piping System Safe: I

Sabin Crocker of The Detroit Edison Co cites advantages a user gets from technical help and shop facilities of piping fabricators for high-pressure high-temperature systems*

▶ MODERN TREND to high pressures and temperatures in steam power and process work necessitates use of heavy-walled carbon-steel piping of superior quality or, depending on service conditions, alloy steels containing moderate amounts of elements other than iron and carbon to increase strength or metallurgical stability at elevated temperatures. Where corrosion is a major factor, larger amounts of alloying elements such as chromium and nickel, are frequently employed.

Heavy construction has, in itself, added to the difficulties of fabrication and erection. Alloy steels require special techniques as well as heat treatment after forming or welding. Where alloy steels are used to resist corrosion, these fabricating problems exist irrespective of the service pressure or pipe-wall thickness required. More care and skill are called for in all phases of design, fabrication and erection than would suffice for ordinary carbon-steel construction for moderate pressure and temperature. Hence the more difficult jobs, particularly those coming under ASME *Boiler Construction Code* and the power section of the *American Standard Code for Pressure Piping*, should be undertaken only by those well versed in these matters, who possess adequate facilities to carry out various stages of the work.

A greater percentage of fabrication can advantageously be done in the shop where facilities are better than in the field, leaving only the simpler operations to perform during erection. For the remaining welds that have to be done in position, adequate equipment under careful control is essential, including means of preheating and subsequent stress relieving or heat treatment where required. Sometimes, to meet code requirements results have to be checked by radiographic or other means for detecting flaws.

The importance of securing reliable piping systems for extreme service conditions warrants a review of items that need to be covered from initial layout to final erection. Such a review affords a useful check regardless of whether one organization does all the work, or the owner lets it out to various engineers, fabricators and field erectors. In the latter case it is highly desirable to check all along the line to see that nothing of importance is overlooked.

Engineering Facilities. Beyond ordinary design factors considered in medium-temperature work, due attention should be given to expansion stresses, creep under load, and the extent to which any given material is apt to deteriorate through long periods of exposure to stress at high temperature. The need exists for specifying suitable materials and adequate dimensional standards, and for otherwise meeting code requirements. Only competent en

* Mr. Crocker is a member of several ASA, ASME and ASTM committees concerned with piping codes, specifications and standards. He prepared this article at the request and with the cooperation of the executive committee, Pipe Fabrication Institute. Part II will appear in the November issue of POWER.

gineers of experience with high-pressure high-temperature piping can take full responsibility for design in this field.

Sometimes the owner has an engineering division of his own competent to deal with such problems in complete detail. In other cases the owner employs a firm of consulting engineers to handle the design work for him. In either situation, there is a trend toward preparing only preliminary studies and layouts of the piping, leaving detail of individual fabricated assemblies to the fabricator. Under these circumstances, the fabricator assumes much of the know-how for doing the job and responsibility for correct interpretation of the design requirements. In carrying out this responsibility, several leading fabricators have developed highly competent engineering staffs and undertaken extensive laboratory work and other research on metallurgical and engineering problems confronting their customers as well as themselves.

Fabricators' Function. Among engineering services commonly requested of fabricators are (1) checking preliminary designs for economics of piping cost (2) detailing individual piping assemblies ready for fabrication and erection (3) checking velocities, pipe diameters and required wall thickness (4) checking code requirements for dimensional standards and materials (5) checking expansion stresses and thrusts to assure adequate flexibility (6) checking hangers and anchors to support the line safely and to control movement and (7) providing correct pitch for hanger spacing to avoid pocketing condensation in the sag between supports.

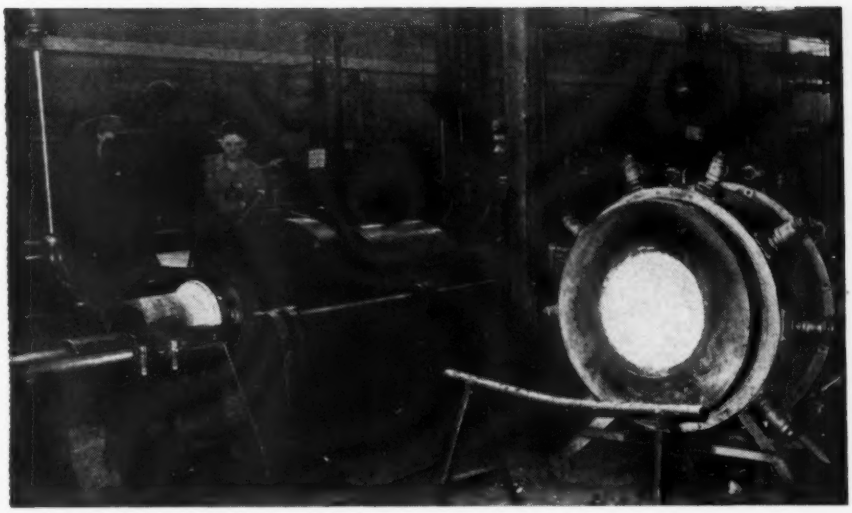


Fig. 1—Equipment to heat and to roll lapped joints and to upset pipe ends. Right: the heating furnace. Left: machine for rolling and upsetting pipe ends

Many fabricators have staff members who take an active part in committees of American Standards Association, American Society for Testing Materials, and other engineering societies concerned with piping specifications, codes and welding. In this way they contribute to and keep posted on current developments in piping technology. Several progressive fabricators were conspicuous among the interests who contributed laboratory work and metallurgical services in investigating graphitization.

Fabricators can offer assistance in selecting alloy materials and in writing welding and stress-relieving specifications for alloy steel. Several fabricators now maintain research and development programs to select and test various alloy steels for all service conditions. They are developing welding methods, bending techniques, welding electrodes, proper preheating procedures and stress-relieving times and temperatures for the fabrication of these materials.

Shop Personnel. In addition to advantages of using the services of the engineering staff associated with a modern pipe-fabricating shop, personnel and facilities of the shop itself tend to assure a high-quality standard of work. The better shops are equipped with tools, jigs and fixtures manned by well-trained and skillful operators working continuously on similar classifications of work under practically ideal conditions. Adequate supervision and inspection insure maintenance of accurate control of quality and dimensions. Certification of mill tests on materials and hydrostatic tests on shop assemblies are provided if required.

With modern prefabricating methods each subassembly is detailed separately. This practice serves as an additional dimensional check on assembly drawings and as a record for reference. A fully detailed drawing helps detect and eliminate discrepancies and makes it easier for shop men to avoid errors.

One great advantage of shop fabrication is the practicability of furnace stress relieving or otherwise heat-treating entire subassemblies including branch connections and other irregular-shaped welds, not only more economic-

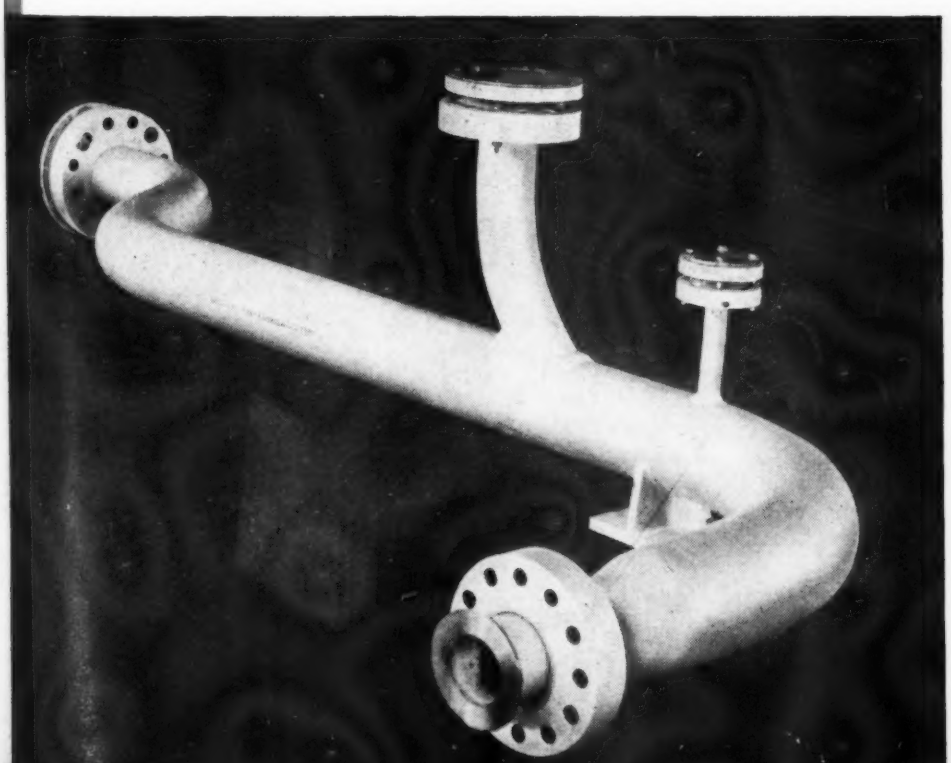


Fig. 2—A typical assembly of prefabricated piping including bends, outlet connections, flanged ends and support completed in pipe-fabrication shop

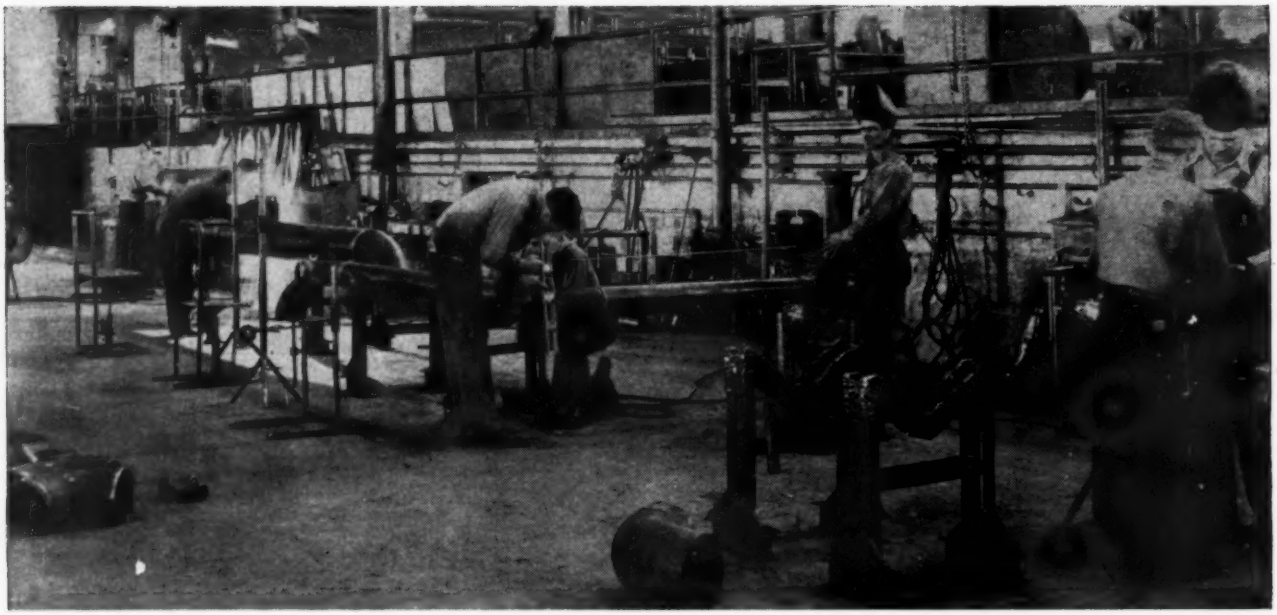


Fig. 3—Typical shop facilities for laying out, fitting and tack welding subassemblies preparatory to welding. The same setup is used for checking and correcting any tendency to distortion that may be caused by the heat

ally, but more safely in view of the recently discovered tendency for welded joints to graphitize**. Where the whole welded assembly can be heat-treated in a furnace, temperature gradients are completely removed as a cause for graphite to segregate. While, in a given piping system, this leaves remaining field welds as a possible source of trouble from graphitization, branch connections and other complex welds are thus immunized.

Shop Facilities. Another real advantage in shop fabrication of as many subassemblies as possible is that a better job of hot-bending heavy-walled pipe can be done with (1) special equipment for sand packing (2) furnaces for heating uniformly preparatory to bending (3) optical pyrometers and other instruments for temperature control in experienced operators' hands (4) bending slabs laid out with dimensioned squares and equipped with jigs, mandrels, templates and chain falls.

Sand packing, impracticable in the field, can be adopted to prevent buckling and for other reasons. With sand-packed pipe, water from a hose can be used for hot bending if and as required: Presence of a mass of hot sand inside the pipe acts to reheat the metal after water quenching, thus relieving unequal strains that might otherwise cause trouble. After bending, the pipe can be cleaned by available power-driven brushes and turbining devices.

For alloy-steel pipe bends and welded subassemblies, some form of heat treatment, in a furnace large enough to take the whole piece, is essential. Satisfactory temperature distribution and control are important. Also, the furnace should be housed where the withdrawn hot charge is properly sheltered against weather and cold drafts.

In a well-equipped shop proper care is exercised in bringing the charge up to temperature and in getting down to 1000 F, or below, on cooling. The whole operation is conducted under metallurgical supervision to insure the desired results with uniform structures throughout the material. With 18% chromium and 8% nickel steel and other austenitic steels, wholly different bending procedures, temperatures and heat treatments are required from those customary with carbon and low-alloy steels.

The possibility of cold-bending pipe offers advantages sometimes and there are important shop applications for large power-driven machines capable of cold-bending pipe up to medium diameters. By using internal mandrels, pipe can be bent cold to short radii in such machines without necessity for sand packing to prevent buckling. With proper equipment, the action of cold bending is performed expeditiously. Fabricators are in an excellent position to advise on the merits of cold bending as compared to hot bending for particular applications. For repetitive work in making a number of identical pieces, cold bending is especially advantageous and was extensively used for mass-production shipbuilding during the war.

Forging operations are usually beyond the scope of field equipment and must necessarily be performed in a shop having a wide variety of equipment for the purpose. Among such operations are upsetting, lap jointing, swedging and flaring, all of which require special machine tools and heating devices not suited to field use. With alloy steels, or a finishing temperature too low for the grade of carbon steel used, a furnace-heat treatment may also be advisable. Owing to the need for judicious use of water to control metal flow and to the high degree of skill otherwise required, such operations are entrusted only to experienced personnel under competent metallurgical supervision.

Shop Welding. Although excellent welding can be done in position during field erection, shop welding is desirable wherever possible because facilities are greater and supervision better. Beveling pipe ends for welding is done to better advantage with a power-driven machine than with portable machine tools or hand-guided torch plus grinding on the job. Although field methods turn out an acceptable job, they have the usual drawback of undue dependence on the human element for perfection in hand-and-eye control.

Hand-operated cutting torches should not be used in pipe fabrication unless the parts to be welded are ground afterwards or otherwise made smooth. A small amount of scale left on the surface

** See Part II, which will appear in the November 1946 issue of POWER.

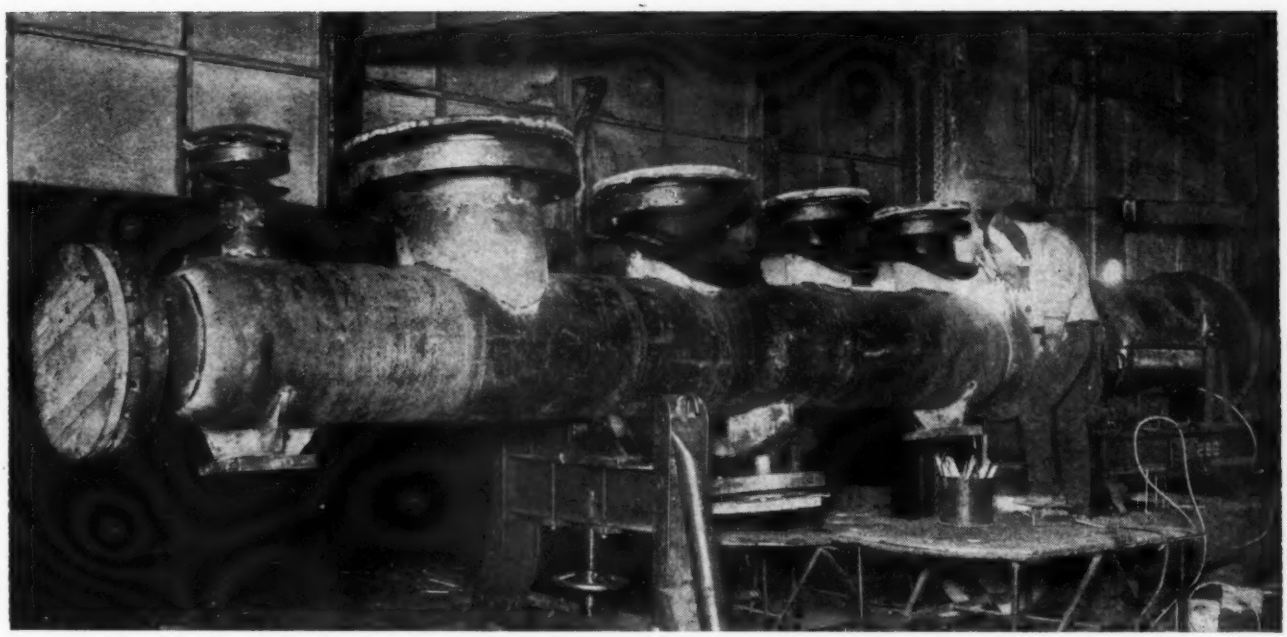


Fig. 4—A roller mounting for supporting a subassembly during the welding so that it can be rotated by a power drive that suits the convenience of the operator at all times. The welding bead can be cleaned during rotation

of a torch cut is not detrimental to the finished weld, since the heat of welding in combination with the fluxing action of the rod or electrode coating should be enough to clean the surface, but rough or grooved cuts are a sure cause of gas pockets and slag inclusions along the line of fusion.

Likewise, where tapered or recessed backing rings have to be fitted inside the joint, a better fit can be obtained with machine tools in the shop than is possible by field methods. With subassemblies, as distinguished from position welding, it is often possible to reach inside the pipe after welding to clear out weld spatter or to remove backing rings from accessible joints, should this be desired. Such joints can even be backwelded, if desired, as work progresses.

In the shop also, fit-up facilities are available in the way of cast-iron plane tables with squares and angle protractors of steel and other conveniences including the services of a well-manned tool room for regular check-up of these instruments. For generating the complex curves for welded branch intersections, special oxyacetylene cutting machines are available with mechanically guided torches. These serve also to form plates for anchors, guides and reinforcement shapes.

In the welding itself considerable benefit is gained by prefabricating subassemblies where the work can be rolled during welding instead of resting in position during erection. Roll welding is advantageous, because not only can less skilled workers turn out equivalent results, but the best operators trained in position welding work faster and to better advantage when the assembly is placed in a really accessible position where it is turned as desired, Fig. 4. Operator can clean each bead of welding during rotation. Movement is accomplished by a power-driven device actuated by a foot switch. Means are available for preheating the work from the inside or underneath so as not to interfere with rotation.

Proper Electrodes. Whether the job is done in shop or field, welding electrodes should be chosen to suit the type of work and material being welded. "Open" rather than "killed" carbon steel is used for the electrode core in welding ferritic steels while the coating contains, in addition to fluxing material, such alloying elements as may be needed to secure deposited metal of the same composition as the pipe, although some low-alloy electrodes have the alloying elements in the core wire. For welding austenitic steels and the higher-alloy ferritic steels, core of the electrode is of similar alloy. Choice of electrode should be based on experience and trial welds rather than on the assumption that some untried electrode necessarily gives desired composition of weld metal.

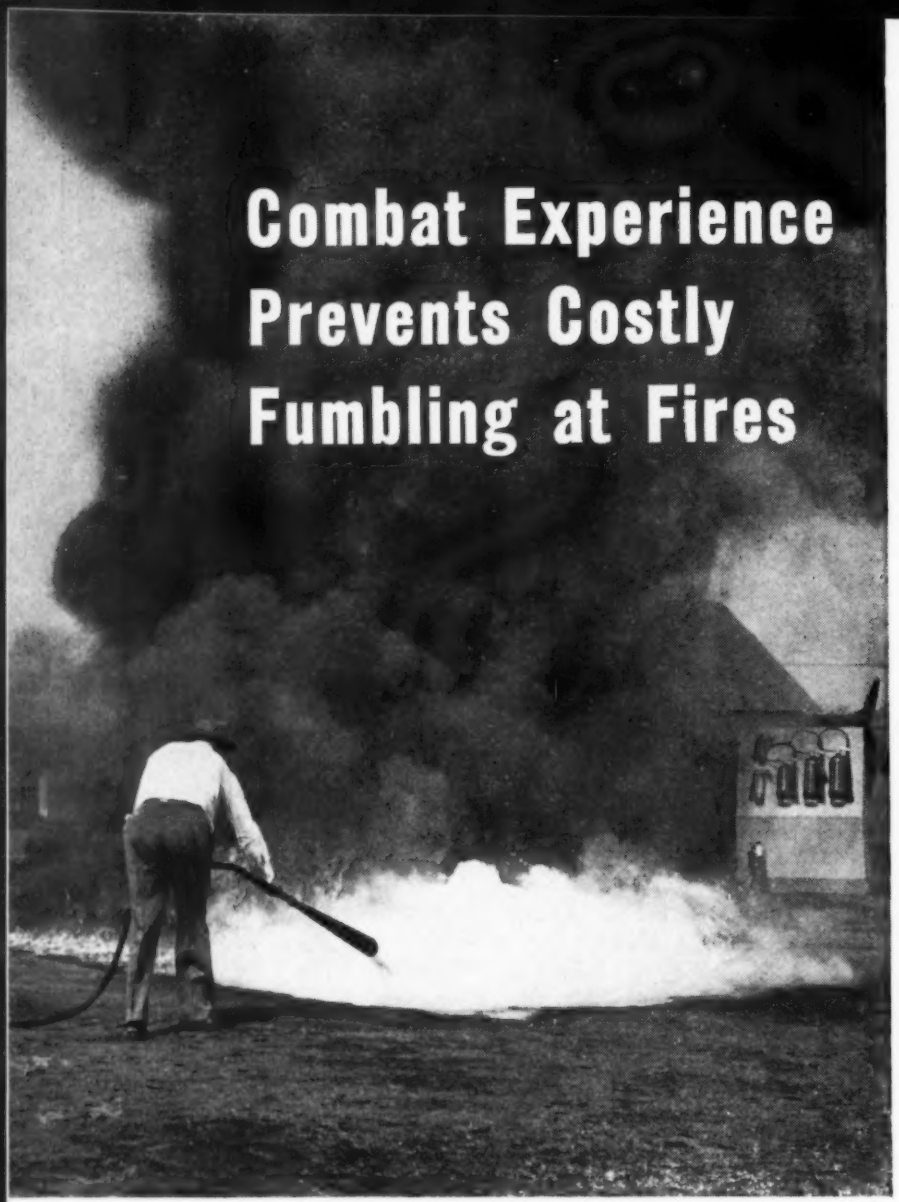
For testing and inspection, shop facilities also offer advantages in fabricating subassemblies. Hydrostatic tests are easily arranged. Certain parts of the *Boiler Code* require radiographic examination with X-rays or gamma rays. The trend among progressive fabricators is to radiograph high-pressure piping regardless of code requirements to maintain and assure control of weld quality.

In the shop, also, valve bodies and other piping items can be checked for surface cracks and defects by magnetic particle testing or with fluorescent penetrating liquid. These types of inspection are especially useful in finding flaws in beveled ends and mitered branch connections before welding.

Devices are available for permanent marking of piece numbers, materials and locations if required for handling, erection, or as a future record in place. Certification of mill tests on materials and shop tests on the product can be had if desired. Fabricators keep records to assure that proper material is taken from certified stocks, following specifications for pipe fittings, flanges and other items of each subassembly.

A further advantage of shop welding is that machines are permanently available in place, with supervisory personnel nearby. Less effort is required to take the work to the welder than in moving men and equipment around on the job. Preheating and stress relieving can also be done more expeditiously in the shop than where bulky equipment has to be transported to relatively remote locations on a construction job. The fewer joints left for field welding the better, but due consideration has to be given to keeping size of subassemblies within practical limits for shipments and hoisting into place.

Combat Experience Prevents Costly Fumbling at Fires



By turning out confident, efficient firefighters a training program guards against frantic scrambling for personal safety or portable extinguishing apparatus should a fire break out

► POWER ENGINEERS KNOW that to make a boiler produce steam, fuel must be fed to the furnace, heated to ignition temperature, and supplied with the correct amount of air. Such combustion know-how can be made the basis of a fire-protection training program if firefighting fundamentals are stressed by homely examples, as below:

1. *It is not good practice to attempt to light one pulverized-coal burner from another because the puff may blow out the first burner.* Accordingly, a firefighter can put out a fire by blowing out the flame, or separating it from the fuel supply until the latter cools below its vaporization temperature. This point is further demonstrated by blowing out a match. If we blow it out quickly we simply separate the flame from the flammable vapors; if the blowing is slow the flame is pushed aside and the generation of vapors decreases.

2. *An oil, gas or pulverized-coal flame is extinguished quickly if the furnace air supply is shut off.* A man can, therefore, smother a flame by cutting off its air supply. Smothering is also demonstrated by covering a pail of burning material.

3. *Lighting off and maintaining a good stoker fire is difficult if the coal is extremely wet.* So a firefighter can use a cooling medium to reduce the fuel temperature below its vaporization point. Cooling is further represented by the action of water on wood or other debris.

Fig. 1—If a large pan is not available an oil fire can be made on the ground itself to demonstrate how to douse flames quickly and effectively

There are three types of fires: Class *A*—rubbish, wood, paper and fabrics; Class *B*—oils, greases, paints, etc; and Class *C*—electrical equipment. Most effective way to extinguish Class *A* fires is by cooling. Class *B* fires must be smothered or cooled. Those of Class *C* can be extinguished by smothering and cooling but, for safety, the extinguishing agent must be a nonconductor. Two parts of some types of electrical apparatus are inflammable: conductor covering and insulating oil. Were it not for the electrical hazard, burning insulation could be treated as a Class *A* fire and oil as a Class *B* one. However, safety of men and equipment demands that all electrical apparatus be considered alive; hence the need for a nonconducting extinguishing medium.

USE METHOD THAT SUITS

There is a correct way to fight every fire. Whether the protection is a built-in system or portable extinguishers placed within easy reach of employes, quick and positive action is the only barrier between an insignificant blaze and a costly, deadly conflagration. Installing elaborate equipment, even built-in automatic systems, gives false security if employes are not familiar enough with each piece of apparatus to get it into action on an instant's notice.

Human Shortcomings. Built-in systems are too often expected to be articulate and give warning of human oversight. Just recently a large textile mill burned to the ground with a loss of several million dollars because someone left a sprinkler-supply valve closed after making repairs to the system. The mill was fully "sprinklered" with a

Fig. 2—Used transformer case with oil overflow tests the men's skill

Fig. 3—Water spray extinguishes a large fire and also provides a protective screen for the firemen against the intense heat and the dense smoke

good water supply of adequate pressure.

Fire started in a cotton bale following a direct stroke of lightning nearby. According to reports the watchman apparently extinguished the fire but did not notify anyone in authority. Two hours later he found the building full of smoke and the fire again burning.

Water was available from a 50,000-gal tank and the electric fire pump was started. Employes put hose streams into use and nearby fire departments arrived, but by that time floors had collapsed in the burning building, breaking the pipe below the closed valve in the first story. This bled other sprinkler systems, allowing the fire to spread to adjoining buildings.

Several pumpers took suction from yard hydrants, thereby improperly using the fire-pump output, instead of securing additional water from a nearby pond. Soon after, heat broke a transformer insulator and pump power failed. As the water tank was then empty, the pumpers had to change to the pond supply. But the fire jumped a narrow alley and, just because one valve was left closed, the boilerhouse and all the main manufacturing structures were completely destroyed.

USE THE SPRINKLERS

On the other hand, closing a sprinkler valve too soon may prove a serious mistake. In one plant the engineer unadvisedly shut off the sprinklers when smoke was discovered in a cocoa pulverizer and dust collector because, in the past, employes had quickly extinguished such fires with pails of water. This time they were unsuccessful, and before the sprinklers could be turned on again flames had spread over a considerable area. When sprinklers are fighting a fire keep them in operation until it is completely extinguished, or until it reaches a point where the final smoldering can be handled better by ordinary means.

Check Supply Valves. Fire-insurance engineers report that they find many sprinkler-supply valves closed when they should be open. Chief danger comes when piping changes are made to a system. If not properly supervised, valves may easily be left closed and forgotten, or the reopening unnecessarily delayed. Other closings are attributable to (1) mistakes resulting from unfamiliarity with piping layout and (2) tampering by unauthorized people; keeping valve handwheels sealed discourages such thoughtlessness: a broken seal gives quick evidence that a valve should be checked.

For maximum safety, fire protection must be designed into the plant so that the best firefighting medium is selected for each hazard. Where built-in systems, such as sprinklers, piped carbon dioxide and hose lines are not adaptable, portable extinguishers can be placed at strategic locations near specific fire hazards, but not so close that they will be involved if fire occurs. If the hazard is inside a small room mount the extinguisher just outside the door. It can be mounted with hangers, or set on a bracket or shelf on a wall.

When portable extinguishers provide general protection for an area containing normal fire hazards, space them so that at least one large or two small ones can be reached by traveling not more than 50 ft from any point in the area. Even in areas protected by automatic built-in systems portable extinguishers find wide use in extinguishing small fires before enough heat is generated to trip the built-in system. There are few fires that cannot be easily put out if discovered immediately and handled properly. Portable extinguishers are designed to cope with fires in the incipient stage (just beginning to exist); automatic systems and hose lines provide the second line of defense, being called into action only if fire is discovered too late, or cannot be brought into control with portable extinguishers.

PRACTICAL PROGRAM

Value of Training. A plant may be completely equipped with the best obtainable firefighting equipment advantageously placed, but unless the people who must handle the apparatus understand it and have been trained in its use the job of fire protection is only half done. Ability to recognize a hazardous condition promptly is fully as important as spotting an actual fire, smelling smoke, or noticing an alarm signal. Once a fire starts, the first person to detect it must be able to decide whether to give an alarm and summon help, or attempt fighting it with the nearest adequate portable extinguisher using the

Fire-Prevention Week
October 6-12

Fig. 4—Metal upright and perforated bucket can be used to simulate a wall or paint locker where fire may occur

Fig. 5—To do the right thing at the right time, firefighters must learn to size up a situation at a glance

Fig. 6—Instructor explains the working parts of a cutaway model to a group that is small enough to put into practice the instructions they are receiving

only technique he knows. Exercising correct judgment makes the difference between a negligible incident and a major disaster. Here training is of paramount importance and should enable the person discovering the fire to do the right thing at the right time. A good firefighter sizes up the situation at a glance. He knows which kind of gas mask, if any, to wear, which extinguisher to use and how to apply artificial respiration to victims of smoke.

RECOGNIZE THE HAZARDS

The general principles of protecting property against fire are simple; in fact, good housekeeping methods will prevent most fires. However, safety cannot be assured by any single measure, such as fireproof construction or isolation of hazardous materials. In addition, every employe must be able to recognize and correct unsafe conditions and be prepared to act decisively and correctly when an emergency arises. Every person in a plant must be continually aware of fire hazard and able to realize the consequence of neglect or wrong acts. Only way to guarantee this is by thorough training and frequent practice.

Giving this training to every person in a plant is a big problem but it is the only way to assure safety to the plant and everyone in it. Training must include actual practice for students as well as demonstration of proper procedures. Perhaps the problem can be simplified in large plants by organizing fire brigades. Judicious selection of employes from each department will distribute sufficient trained fighters throughout the plant to direct the actions of others at a fire.

Keep Groups Small. Training groups must be kept small; otherwise time does not give each individual a chance to practice the instructions he is receiving. Best results are obtained by an informal explanation of the subject being studied so as to encourage questions. Then have each participant actually use the apparatus until he is confident he can duplicate the operation in an emergency. For instance, if the subject is gas masks, make the test real by burning one or two sulphur candles in a closed room fitted with a window through which the occupants can be observed.

Explain the workings of the mask, how to put it on, and test the face piece for leakage (How To, POWER, p 122, October 1944). Then have each person don the mask, test it, walk into the room and remain several minutes. After emerging, have him take a whiff of the sulphur to get a good idea of the odor that was in the room, even though the air he breathed through the mask while there was as pure as that outdoors.

LIGHT REAL FIRES

Again, if the subject is fire extinguishers, real fires should be lighted for each participant to put out. Debris and oil-pan fires, as well as a dummy oil circuit breaker or transformer case etc. can be arranged to simulate actual plant conditions. Timing each person adds a little competition, which encourages him to proceed quickly and efficiently. Thus, everyone learns the best as well as the quickest way to extinguish a fire.

As for artificial respiration, no elaborate setup is required. Members of a group can practice on each other until they know how to prepare the victim and apply resuscitation. Here the instructor times the strokes and checks each operator's movements, pointing out to a heavy person the danger of bearing too much of his weight on a small person or child.

Training demonstrations are important because they (1) help eliminate fear of fire among employes (2) develop employe confidence in handling extinguishers (3) provide greater protection for property and employes (4) call every participant's attention to specific hazards in the plant.

Power is indebted to the following companies for the photos in this article: For Fig. 1 and 2, photos are from Walter Kidde & Co, Inc; Fig. 3 and 6, from Consolidated Edison Co of N. Y., Inc; Fig. 4, from Ansul Chemical Co; Fig. 5, from Cardox Corp; Fig 7 and 8, from Pennsylvania Water & Power Co.

Fig. 7—Operator practices adjusting water spray as he plays the hose on tank and ground fire to test results

Fig. 8—Let each member of a group practice with every type of fire extinguisher that is on hand in the plant

CHEMICAL CLEANING Takes the Bull Work Out of Scale Removal: II

In selecting solvent and additive agents, analyze the scale fully or subject it to a solubility test. Here's how experienced personnel take a sample for analysis, heat the solvent, carry out the treatment

Portable pyrometer or thermocouples attached to the boiler parts check temperature of the metal

By E W FELLER, *Associate Editor, Power*
GUY F WILLIAMS, *Dowell, Incorporated*

▶ MOST IMPORTANT STEP in preparing for a chemical cleaning job is taking a scale sample and analyzing its constituent elements. A boiler sample should represent the hardest, densest scale in the unit, usually found in the hottest tubes. On heat exchangers, such as condensers, evaporators and economizers, remove sample from the inlet section where heaviest deposits form. Take it down to bare metal. Preferred method is to remove a small section of tube containing the scale, but where this is impracticable take the sample in chunks rather than in powdered form.

Scale tests provide information needed to determine: (1) type and strength of solvent (2) amount and type of other additive measures—wetting agents and intensifiers (3) best metal and solvent temperature (4) contact time (5) application process.

Scale Analysis. In properly analyzing scale it is first examined for (1) density (2) porosity (3) thickness and (4) formation—whether it consists of more than one material or exists in different layers. After this general examination its chemical compounds are identified by their X-ray diffraction patterns, or if this is not necessary, simple solubility tests are made. Advantages of X-ray analysis are: (1) Substances appear in their true state of chemical combination. (2) Results are conclusive even on a small amount of material. (3) Sample is not destroyed and can be filed as a permanent record.

X-ray analysis permits rapid selection of the solvent best suited because it positively identifies the scale constituents. In his original work on X-ray chemical analysis Hull states: "Every crystalline substance gives a pattern; the same substance always gives the same pattern, and in a mixture of substances each produces its pattern independently of the others, so that the photograph obtained of a mixture is the superimposed sum of photographs that would be obtained by exposing each of the components separately for the same length of time."

The work of Hanawalt and others, in classifying thousands of different chemical substances so they may be easily used for identification of an unknown even if it is a mixture of substances, has made the Hull method of X-ray analysis practical and valuable to chemist and engineer interested in identifying scale-forming materials.

Solubility Test. After determining the scale's chemical characteristics, see table, solubility tests, which take into consideration time, temperature and manner of solvent application, are made on several samples to determine solvent makeup and treating technique. Tests are made in three ways :

1. An accurately weighed sample is placed in an excess-acid solution. When reaction is complete, the residue is washed, dried and weighed. Difference between original and residue weight, divided by the original weight and multiplied by 100, equals the solubility percentage.

2. A measured volume of the sample is placed in an excess-acid solution, and the volume dissolved is calculated.

3. Fastest, most generally used and accurate method measures the quantity of CO_2 evolved by acid acting on one gram of the sample.

The solubility-testing apparatus, Fig. 1, may consist of a small flask equipped with a 2-hole rubber stopper, through which is run a separatory funnel and delivery tube (*The Acidizer*, Vol 5, No. 3). Both tube and funnel connect to a 12-oz wide-mouth water-storage bottle containing a thistle funnel and delivery tube leading to the 200-ml graduated cylinder. Top connection to separatory funnel equalizes gas pressure below and above the acid, and corrects for acid entering the flask. A 25-ml graduate and balance completes the test equipment.

Preparing Sample. Before starting a test, storage bottle is filled with water, one gram of sample put in the flask and 25 ml of solvent poured in the separatory funnel. Connecting lines must be gastight. Opening the stopcock admits acid to the sample, and CO_2 evolved in the reaction forces water from storage bottle over into the graduated cylinder where it is measured.

Chemical equation for the reaction shows that introducing 15% hydrochloric acid to a one-gram sample of calcium carbonate evolves 224 ml of CO_2 at zero C and 760 mm Hg. Using this figure (224 ml) as 100% find the solubility of a sample by computing the water volume displaced in percentage of the 100% figure. Calibration must also consider temperature and atmospheric pressure at test location. Tests in Fig. 2 were made at 75 F and 740 mm Hg.

Some discrepancy arises when the

sample contains other acid-solvent material, such as magnesium carbonate, because additional CO_2 given off during the reaction indicates a solubility greater than 100%. The same reaction with one gram of magnesium carbonate evolves 226 ml of CO_2. To interpret the results correctly requires knowledge of the scale elements and the approximate amount of each. Best purpose of the device is to determine what solvent shows the highest solubility rate on the scale sample.

Chemical cleaning is efficient and timesaving in getting equipment back in service. It cuts outage time from days to hours. Other advantages are :(1) Solvent penetrates to inaccessible parts of vessel and tube bends. (2) Major dismantling of equipment is unnecessary. (3) Metal loss is inconsequential. (4) Pits and corrosion areas are exposed. (5) Scale is removed completely. (6) Shutdown time is greatly reduced. Cost of subsequent cleanings is generally lower than the first because of initial material and time-consuming operations peculiar to each plant. To illustrate possible savings, one plant made the following reductions (1) total charges, 34% (2) material costs, 37% (3) time charges, 32%.

Cleaning Procedure. In removing scale chemically the boiler or heat exchanger is taken out of service, drained and properly isolated from remainder of system by closing the necessary valves or installing blind flanges in the pipelines. Prepared solution at the prescribed temperature is pumped, through a bottom connection, into the unit (which has been preheated) until it is full. The solvent may be recirculated continuously, intermittently, or allowed to stand and soak the scale.

Meanwhile, solvent samples, removed from strategic points at regular intervals as treatment proceeds, are tested for solvent acidity, some dissolved scale constituents, metal content, and temperature, and the results recorded, Fig. 3. After the solvent is spent, or its strength remains steady for several readings, the solution is drained to the sewer and the vessel rinsed several times with clean hot water. Draining can be speeded up by substituting a blind flange, fitted with a large valve, for the manhole cover in lower drum. Cold water sets up undesirable strains in the boiler, and raw or untreated water may leave a dirty film on the metal.

Final Treatment. Final cleaning operation is to fill the boiler with a 1% solution of soda ash or caustic soda, using 100 lb to 1000 gal of water, and boil it at 10 psi for two hours. This operation (1) prevents after-rusting (2) neutralizes all trace of acid (3) removes residual scale particles and remaining inhibitor or wetting agent (4) purges the boiler of hydrogen. Precipitation of acid-soluble material is prevented by flushing the unit enough to discharge acid-free water before introducing the caustic solution.

Usual procedure is to blank off the superheater to prevent solvent entering it unless it is to be cleaned with the boiler. If it is to be flooded instead of being blanked off, see that a small quantity of water is pumped back occasionally through it into the boiler, and when the boiler is being washed pump considerable water in through the superheater. In nondrainable superheaters, each tube must be flushed individually. If economizer is to be cleaned it is generally filled with solvent and allowed to stand while boiler is filling. Otherwise, flood the unit with water or blank off the piping.

When pumping a diluted solvent into a boiler the filling line usually connects at the bottom or another low point. If concentrated inhibited acid is to be added to a unit already containing hot water, the acid is generally introduced at a high point, such as the drum or upper waterwall header. Intricate boiler designs may require several filling lines. Always run a vent line from a top boiler outlet (safety-valve flange) to outside of building.

If the boiler is to be treated only to normal water level, the solvent return line is sometimes omitted, but if the steam drum requires cleaning, a return is generally installed. Here the return line and relief vent can connect to the same boiler outlet, each being equipped with a valve. During filling, return valve is closed and vent opened, but just before boiler is full return-line valve is opened and the vent closed. After boiler and return line are full, vent valve must be opened. Lock and tag all pertinent valves so they will not be operated by mistake.

Circulating the Solvent. It is generally not necessary to circulate the solvent continuously. Analysis on solvent samples during circulation indicates that the major drop in acid strength occurs during the first few minutes in the vessel. Also fluid velocity is not high enough to produce any appreciable scouring action so the normal procedure is to fill the unit and let it soak. However, circulating facilities might be made available if desired. On the other hand, a certain amount of gravity and thermal circulation takes place during the soaking period because the solvent's specific gravity increases as it reacts with scale and the heavier spent solu-

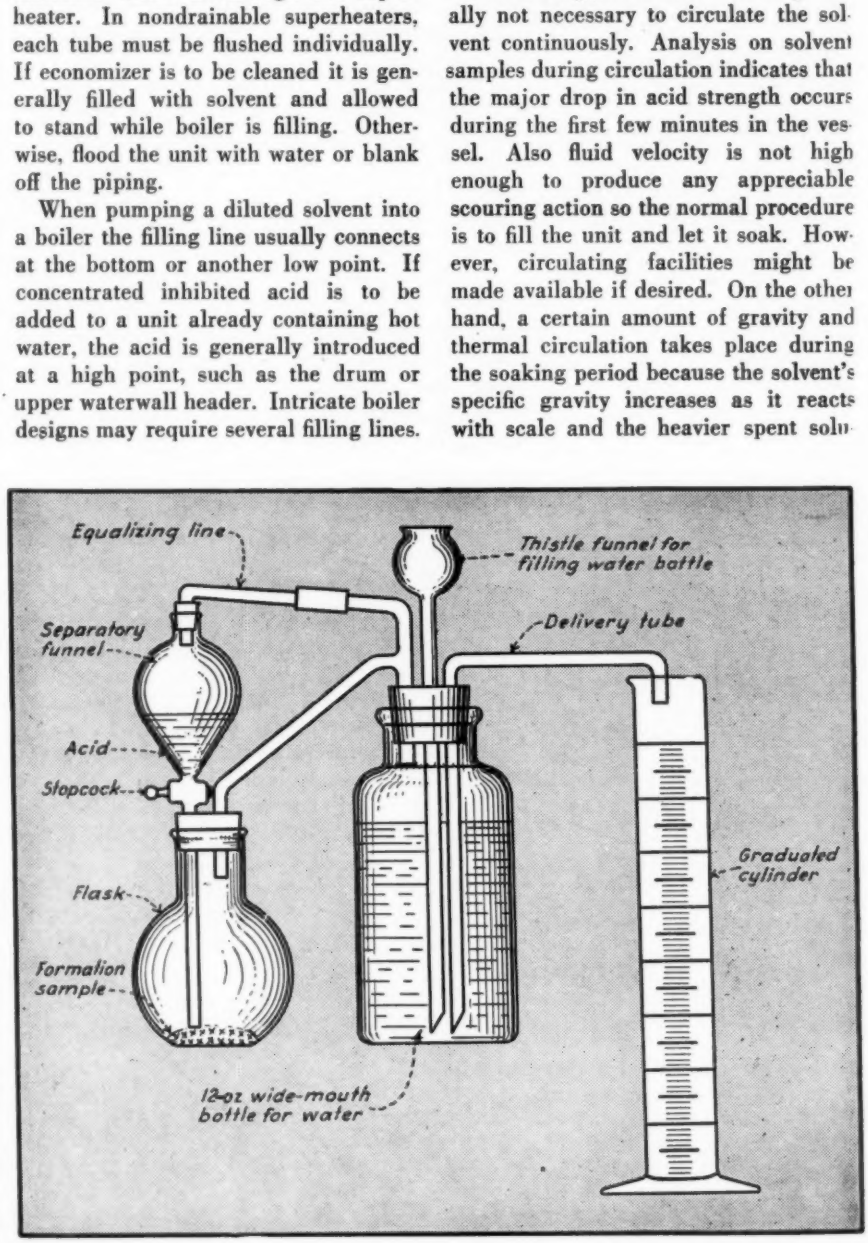


Fig. 1—Solubility of the scale sample in acid is determined approximately by measuring the water forced over into graduated cylinder by the gas evolved

tion falls to the bottom. Exception is a heavily scaled unit or one that requires several fillings to remove the deposit. The time solvent-strength curve flattens out when all scale is dissolved, Fig. 3, and a spent solution may indicate the need of another application.

Loose scale and mud should be hosed out of the vessel so that solvent will not be used up on this material. Also, inspect blowdown or drain valves and make them tight against leakage. Locating important valves so they can be put under a head of water prevents the solvent reaching them. Where two valves are in a connected line apply water pressure between them to prevent acid backing up into the system.

It is important to have the boiler warmed and the solvent at the proper temperature before introducing the solution. Best solvent temperature depends on its composition and boiler metals. Generally it should not exceed 160 F. It is not necessary to maintain this temperature throughout the soaking period on most boilers although it can be controlled somewhat by closing up or ventilating the furnace as required. Guard against excessive air leaks into furnace.

Typical Plant Practice. In one plant, a 1400-psi 600,000-lb-per-hr boiler accumulated a quantity of scale and sludge after four months' operation. Scale analysis showed 0.32 to 1.35% copper and 1.71 to 5.29% silica. The remainder consisted of iron oxide and phosphates. Treating setup included hydrogen evolution-test equipment and thermocouples installed on each downcomer and other strategic points to read temperature. Boiler was heated to 160 F before solvent was introduced, and treatment applied in two stages; first application required three hours, and second, four hours. Economizer and superheater were filled with water. Boiler was kept closed and vented outside the building until it had been cleaned and flushed to eliminate hydrogen hazard. Final operation was to boil a 1% soda-ash solution in the unit.

Second filling took 170 gal more solvent than first, which was partly attributed to sludge dissolved in first treatment. Cleaning operation removed 2000 lb of phosphate sludge and 1400 lb of iron-oxide scale.

Preparation to clean a forced-circulation unit included: (1) removing orifice and strainer assemblies (2) plugging all devices connected to wet drum—water column, steam gage and water-level indicator (3) applying 50-psi water pressure to circulating pump and feedwater lines to protect valves (4)

BASIC AMOUNTS OF HYDROCHLORIC ACID

Required to Dissolve Scale in the Laboratory

Scale		Gallons 15% acid to dissolve	
Compound	Formula	1 Lb	1 Cu Ft
Calcium carbonate	$CaCO_3$	0.55	93
Ferric oxide	Fe_2O_3	1.22	399
Ferric oxide (magnetic)	Fe_3O_4	1.06	343
Ferric oxide (hydrated)	$FeOOH$ or $FE_2O_3H_2O$	0.92	230
Phosphates	PO_4	—	105

filling the unit with city water and firing it intermittently to heat the metal parts to 175 F (5) draining the boiler so a head of water submerged all important valves, circulating pump and blowdown.

Economizer was treated and the boiler filled to bottom of dry drum, and 100 gal of fresh solvent were added every two hours during the soaking period. Samples were removed from the overflow for analysis. No draining was done through blowdown or regular drain valves. The economizer was filled with water as soon as solvent emptied out; all valves protected by a water head were thoroughly flushed. Main circulating pump was operated during the 1% soda-ash boil.

Heating Procedure. Heating the boiler metal before treatment is done by: (1) circulating hot water through the unit (2) using the lighting torches or small burners on oil, gas or pulverized-coal-fired boilers to heat them (filled with water) (3) introducing live

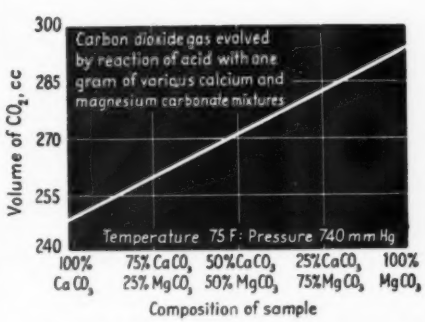


Fig. 2—CO_2 evolved from sample made of calcium and magnesium carbonates

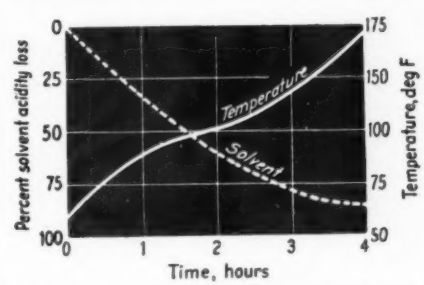


Fig. 3—As soaking continues and temperature rises, the acid gets weaker

steam into the water-filled boiler. This is not entirely satisfactory because it develops serious water hammer. When using the firing method exercise extreme care after cutting the fires so refractory and boiler-surface temperatures are equalized before draining the water. Boiler must not have any hot spots when solvent is introduced. *Never heat a solvent-filled boiler by firing the furnace.*

Cleaning solution can be heated by direct contact with steam or by passing it through a heat exchanger. A hydrochloric-acid solvent can be heated by adding magnesium to it. Reaction of each pound of magnesium liberates 8400 Btu, or enough to raise temperature of 1000 gal of 15% acid 1.2 F. Procedure is to drop the required amount of magnesium in the solution, or pump the solvent over a piece of the metal suspended near the point of treatment. Varying the amount of metal or the pumping rate gives the desired temperature. Acid solution is weakened only slightly in the reaction.

In preparing a condenser for chemical cleaning, wash it out and replace all leaking tubes. Test the drain and discharge valves. If they leak blank them off. Best practice is to blank off both the condensate and evacuator or vacuum-pump line. If both steam and water sides are to be cleaned simultaneously, block the supporting springs because they are not designed to support both sides filled with water. Be sure the supporting structure will sustain the added weight.

Provide some means of determining the solution level. When cleaning the steam side arrange for removing sediment from the hotwell. After treatment, water side requires only complete drainage and hosing out at blind flanges or bulkheads. Steam side must be drained and flushed with water; then hotwell is cleaned. Final operation is to flush all surfaces with condensate.

Turbine Cleaning. Caustic solutions have removed deposits from steam turbines, and preliminary experiments are

now being conducted using acid vapors or fog. In one instance a 10% caustic solution was injected in the steam line at 2 gpm while sufficient steam was admitted to operate the turbine at 100 to 200 rpm. After the hotwell condensate showed phenolphthalein alkalinity (period of 45 min) steam was shut off and the process stopped to allow the caustic to react with the deposit. Eight additional 5-to-19-min shots were given, each followed by 15-min reaction period. After treatment, turbine was washed with condensate until water in hotwell showed normal conductivity. Caustic cleaning brought capacity to normal.

Cleaning Water Wells. In cleaning wells chemically, the solvent opens the gravel pack or surrounding formation, and cleans the pumping equipment and screen. Iron oxide or other sediment carried in the water often clogs the critical area within one inch of the bore hole. When the inhibited treating solution is introduced it reacts with the walls of cavities and channels, enlarging and extending them, thereby producing a definite increase in permeability and porosity, Fig. 4. However, gain in porosity is not so important as increased permeability—longer fissures.

Commonest way to treat wells is to pump the solvent directly down the flow pipe and through the pump. This method has the disadvantage that it has no control over placing the solvent, with the result that it enters the formation at points of least resistance. Treating down the casing has the same advantages and disadvantages as treating down the pump and, in addition, it does not clean the pumping equipment so well. If limestone or calcareous material is expected, it is sometimes necessary to inject solvent down the flow line, and at the same time force water down the casing to hold the gas pressure and prevent solvent blowing out.

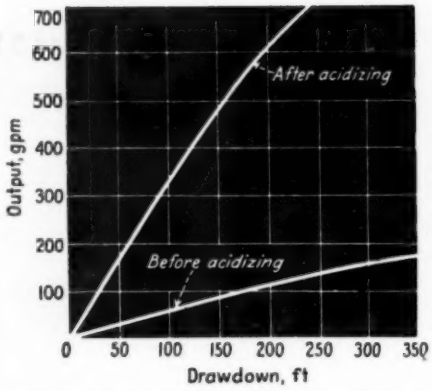


Fig. 4—Acidizing increases the output by enlarging natural water passages

When cleaning only the pumping equipment the solvent is pumped down the flow line and after three or four minutes' soaking time the pump is run until solvent appears. Pump is then stopped and the solvent allowed to fall back. This is repeated at regular intervals. When the water contains considerable iron it is advisable to clean the pump in this way before treating the formation. Surging the solvent by starting and stopping the pump also offers advantages when cleaning the critical area, screen, or gravel pack. Stage treating (more than one application) is frequently used to advantage. If a well supplies water for food processing, or human or animal consumption, solvents, inhibitors and additive agents require careful selection because they must be nontoxic (nonpoisonous).

Some ground formations, usually of limestone nature, react so rapidly with inhibited acid that it is spent before there is much penetration. In such cases an agent is used that retards this reaction, sustains the dissolving action for a greater horizontal distance, and gives increased permeability farther away from the well bore. The retarding agent produces a precipitate on the immediate formation, which offers resistance to acid attack, and it then flows farther into the crevices and water passages.

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Proposed Steam Producer Evaporates High-Pressure Steam Outside Furnace

A steam generator developed by Mark Benson avoids making steam at heat-transfer surfaces by using only economizer and superheater for heat absorption and additional apparatus of standard make for separation needs

▶ BASED ON the commercially successful European Benson boiler operating at or below critical pressure, a modified design has recently been evolved that offers an intriguing prospect of solving some of the feedwater troubles that currently plague operators of high-pressure equipment. Laboratory tests indicate that even salt water can be used as raw feedwater when necessary.

The original Benson boiler, Fig. 1a, is a once-through forced-circulation drumless unit, built principally in Europe for steam conditions from 400 to 3300 psi and 640 to 990 F. At first, considerable trouble was occasioned by concentration of mineral solids on tube walls in the transition zone. These had to be removed by somewhat cumbersome methods until a modification in design relocated the evaporation zone in a region of lower furnace temperature.

Even in the modern version of the Benson boiler, steam forms adjacent to heat-transfer surfaces exposed to furnace radiant heat and high-temperature gas, so relatively pure feedwater is essential. Carryover in these units ranges from 2 to 20 ppm. In the new modification all actual evaporation is accomplished outside the furnace zone with the result that solids can be removed by continuous blowdown.

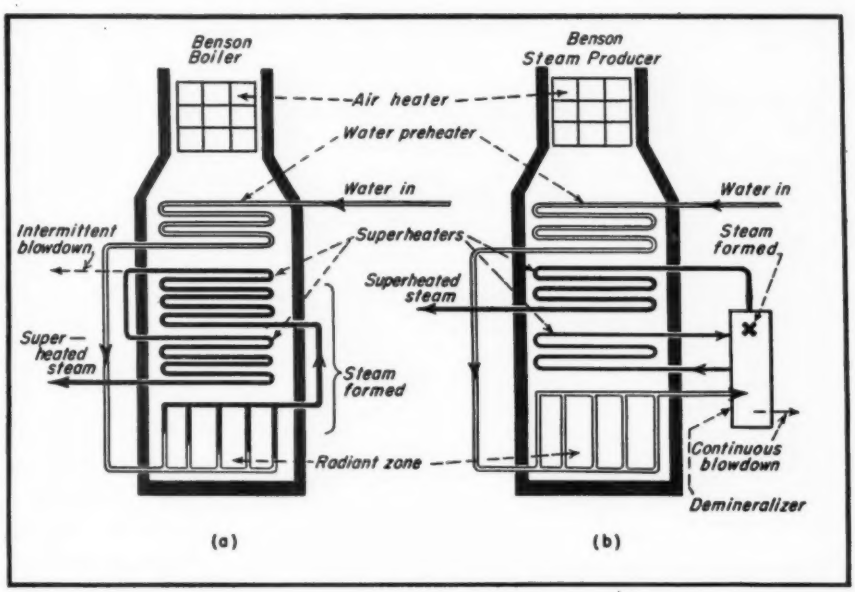


Fig. 1—(a) Benson boiler forms steam in radiant zone and intermediate section (prior to superheater) in which solids are deposited and intermittently blown down. (b) Benson steam producer forms steam in zone external to heating surfaces avoiding solids concentration at heat-transfer surfaces, which consist of an economizer and two superheaters; no boiler as such is included in design

STEAM PRODUCER

In the Benson steam producer, Fig. 1b, it is intended that all steam formation take place in a location remote from the heat-transfer surfaces, aiding in control of scale deposition. High-temperature heat-transfer surfaces are in contact with only water (containing dissolved or suspended solids) or steam. Basically, the steam producer comprises three groups of equipment (1) degassing unit not shown in Fig. 1b (2) heating surfaces and (3) demineralizing system.

In the degassing unit, feedwater temperature is raised to 328 F, high enough to break down bicarbonates and liberate CO_2. About 5 to 10% of the feedwater flashes to steam in the degassing separator, Fig. 2, carrying away CO_2 and O_2. Heat and condensate are recovered in a vent condenser.

The heating surfaces consist of four separate sections: economizer, radiant heater, purifier superheater and main superheater. No evaporation takes place in either of the first two sections, the pressure being maintained above the critical.

In flashing from critical pressure, 3206 psia, through a reducing valve to 3100 psia, Fig. 2, about 50% of the flow becomes steam, see Fig. 4. This high ratio of flashed steam to water for a relatively slight pressure drop occurs only in the region of critical pressure.

The flashed saturated steam at about 700 F returns to the purifier superheater where its temperature is raised to 890 F. The steam now has sufficient heat content to evaporate all but about 2% of the water flow as the two are brought together in a vaporizer and pressure is reduced to about 2800 psia. Remaining water, containing practically all solids, is removed in a separator and trapped to waste. All steam then passes to the main superheater, where it is brought to whatever temperature is required by the prime mover.

Fig. 2 shows flow-circuit details with steam and water conditions indicated at each point in circuit. Fig. 3 shows a layout, roughly to scale, of a Benson steam producer. In Fig. 2, the flow balance is calculated for a net production of 100,000 lb per hr steam at 2700 psia pressure and 870 F.

Here 116,180 lb per hr raw feedwater

enters steam-producer degassing equipment at 14.7 psia and 212 F. Feedwater discharges at about 350 psia from low-pressure pump; it then passes as the coolant through vent condenser and enters a mixing heater where 13,000 lb per hr live steam from producer outlet raises mixture temperature to 420 F at 320 psia. Preferably steam extracted at a lower pressure from main turbine should be used with obvious gain in over-all plant economy.

Water pressure then throttles to 100 psia in the reducing valve and about 11% of heated water flashes to steam. Scrubbing action of the flashing steam in the water helps degassification. In the cyclone-type degassing separator, steam and gas pass to vent condenser where steam cools to water with practically no minerals or dissolved gas entrained. This condensate, representing about 12% of the raw feedwater flow, can be used for makeup in low-pressure boilers, can be recycled or otherwise utilized.

Remaining 115,040 lb per hr degassed water passes through a trap to high-pressure pump suction. This completes degassing unit circuit. High-pressure pump raises water pressure to 3300 psia, discharging it to the economizer. Water temperature rises to critical.

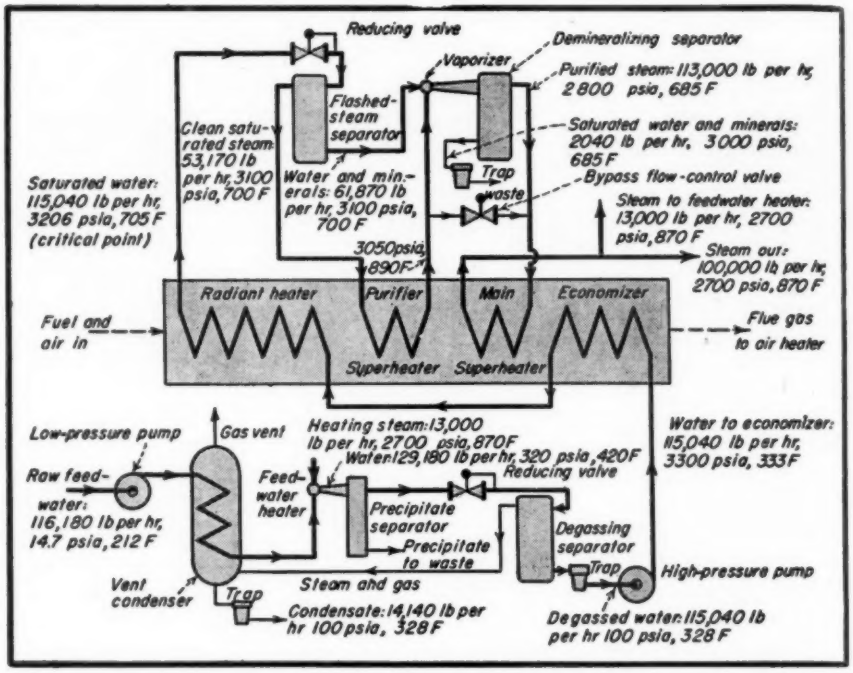
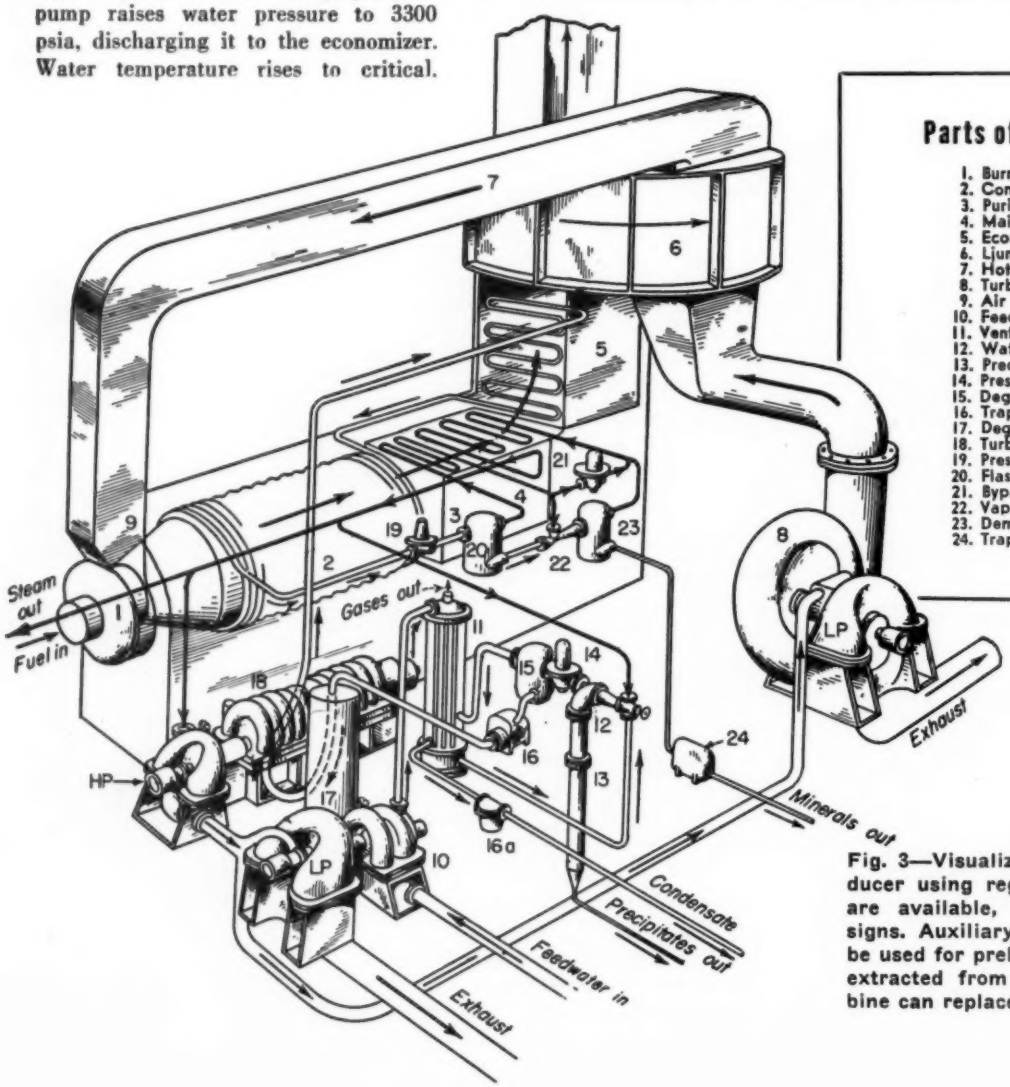

Reducing valve
Demineralizing separator
Vaporizer
Purified steam: 113,000 lb per hr, 2800 psia, 685 F
Flashed-steam separator
Clean saturated steam: 53,170 lb per hr, 3100 psia, 700 F
Saturated water and minerals: 2040 lb per hr, 3000 psia, 685 F
Trap
Bypass flow-control valve
Saturated water: 115,040 lb per hr, 3206 psia, 705 F (critical point)
Water and minerals: 61,870 lb per hr, 3100 psia, 700 F
Steam to feedwater heater: 13,000 lb per hr, 2700 psia, 870 F
3050psia, 890F
Steam out: 100,000 lb per hr, 2700 psia, 870 F
Radiant heater
Purifier
Main
Economizer
Fuel and air in
Flue gas to air heater
Superheater
Superheater
Low-pressure pump
Gas vent
Heating steam: 13,000 lb per hr, 2700 psia, 870F
Water to economizer: 115,040 lb per hr, 3300 psia, 333F
Raw feedwater: 116,180 lb per hr, 14.7 psia, 212 F
Feedwater heater
Water: 129,180 lb per hr, 320 psia, 420F
Reducing valve
Precipitate separator
Degassing separator
Precipitate to waste
Trap
High-pressure pump
Vent condenser
Steam and gas
Trap
Condensate: 14,140 lb per hr 100 psia, 328 F
Degassed water: 115,040 lb per hr 100 psia, 328 F

Fig. 2—Benson steam producer has three main equipment groups: degassing, demineralizing and heating units. Feedwater degassing unit extends from water inlet to economizer inlet; demineralizing unit from radiant-heater outlet to main superheater inlet; heating unit, at diagram center, includes all main heat-transfer surfaces. Steam forms in both flashed-steam separator and vaporizer of the demineralizing unit; no heat-transfer surfaces in these components



Parts of Steam Producer

1. Burner
2. Combustion chamber
3. Purification superheater
4. Main superheater
5. Economizer
6. Ljungstrom air heater
7. Hot air
8. Turbine-driven blower
9. Air inlet
10. Feedwater pump
11. Vent condenser
12. Water heater
13. Precipitate separator
14. Pressure regulator
15. Degassing separator
16. Trap
17. Degassified water receiver
18. Turbine-driven feedwater pump
19. Pressure regulator
20. Flashed-steam separator
21. Bypass flow regulator
22. Vaporizer
23. Demineralizing separator
24. Trap

Fig. 3—Visualization of Benson steam producer using regenerative air heater. Parts are available, standard manufactured designs. Auxiliary-turbine exhaust steam can be used for preliminary feed heating. Steam extracted from generating-plant main turbine can replace live steam for feed heating

705 F, after passing through both economizer and radiant heater, while pressure drops to critical, 3206 psia, at heater discharge because of frictional losses. A reducing valve drops water pressure to 3100 psia, about 50% flashing into steam. Fig. 4 shows the relation between steam quality and final pressure when water at critical point throttles to a lower pressure. Minerals remain in water flow amounting to 61,870 lb per hr. Mineral-bearing water segregates from clean steam in the flashed-steam separator.

Temperature of steam leaving flashed-steam separator rises to 890 F in purifier superheater. Superheated steam and water brought together in vaporizer evaporates all but 2040 lb per hr of the water. The minerals concentrate in this remaining water, forming a sludge, which is removed from the circuit in demineralizing separator and trapped to waste. The 113,000 lb per hr purified steam then flows through main superheater from which it emerges at 2700 psia and 870 F. In this balance 13,000 lb per hr goes to heat feedwater in the degassing unit, leaving net output of 100,000 lb per hr to prime mover.

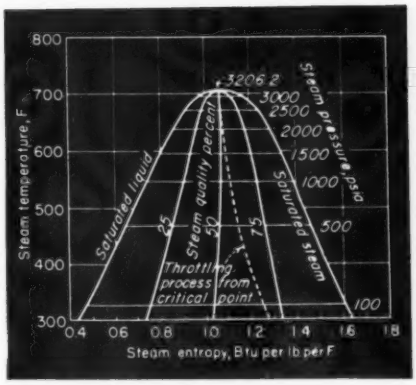


Fig. 4—When water at critical point (3206.2 psia, 705.4 F) throttles to lower pressure, about 50% flashes into steam at pressures in range above 2000 psia

For badly contaminated feedwater additional stages of heating and separation may be utilized in degassing unit as well as additional stages of separation in demineralizing unit.

To check actual performance of degassing and demineralizing processes, a pilot plant has been tested at Joshua Hendy Iron Works in Sunnyvale, Calif. Steam conditions were dictated by the supply available at 100 psi and 700 F.

Tests with cooling-tower water containing 2188 ppm showed demineralization to nonperceptible carryover with sampling methods accurate to better than 1 ppm. When feed was changed to a 4% salt solution (40,000 ppm) analysis with silver nitrate showed less than 2 ppm carryover.

Cooling-tower water contained about 6 cc per liter of dissolved oxygen. Consistent results were obtained with residual oxygen less than 0.005 cc per liter with an electrometric double titration (POWER, May 1944, pp 74-76; June, pp 66-68; July, pp 78-81.)

While the tests have necessarily been conducted at relatively low pressure and temperature, no major problems for operation at higher service conditions are apparent. At high pressure both degassifier and demineralizer are compact.

With the Benson arrangement of heating surfaces, operation of high-pressure steam plants with any ratio of makeup up to 100%, with most waters, even including sea water or blowdown water from other steam generating units, is claimed entirely feasible after a certain amount of operating experience.

Power Engineers Study Smoke Problem

Newly elected Vice-president Joseph P Flynn, Elizabeth, N. J., Chapter 14

After discussing individual problems, delegates from local NAPE chapters tackle ways and means to overcome the smoke nuisance, visit the power show and elect their new officers

▶ AT THE PUBLIC AUDITORIUM, Cleveland, Ohio, Aug 19-23, National Association of Power Engineers held its 63rd annual convention and National Power Show, with approximately 186 delegates, 300 visitors and 180 manufacturers' representatives attending.

First session, called to order by Carl T Sorge, general chairman of the convention committee, featured addresses by Lee Hole, representing Frank J Lausche, governor of Ohio; Warren D Lewis, national president of NAPE; Wayne Stetson, manager of Cleveland Convention Bureau; and George E Wills, national vice-president. In addition to many committee reports and discussions concerning work being done by the association, several educational meetings were devoted to ways and means of licking the smoke problem that confronts many communities.

Efficient Combustion. In the first lecture on the subject, "The Combustion of Fuels," Otto deLorenzi, Combustion Engineering Co, Inc, illustrated his talk with a moving picture showing combustion inside a furnace under different firing conditions.

Joseph Harrington, advisory engineer, Illinois Coal Corp, Sunlight Coal Co and Tecumseh Coal Corp, in his paper, "History of Combustion and Coal-Burning Equipment," pointed out that good combustion depends on the three t's—time, temperature and turbulence. He stated that efficient combustion exhausts a colorless gas and that most of the en-

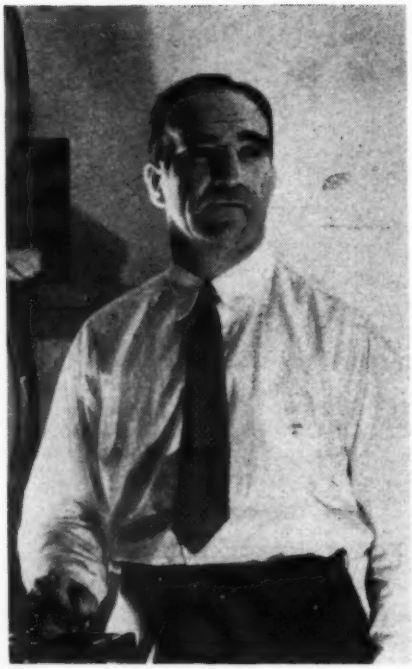
trained solids in smoke are rich in Btu's.

His answer to the smoke problem is to convince the plant owner that a small investment in more efficient coal-burning equipment pays for itself in several years by burning carbon that formerly went up the stack. Harrington also suggested that every engineer inspect his furnaces to see that sufficient combustion space is available and that arches are designed to give maximum turbulence. To stoke a furnace smokelessly requires that (1) coal be fed in small amounts (2) fuel bed be even in thickness without holes (3) ash be removed uniformly. Fuel-bed clinkers short circuit the air flow and cause blow holes. Also, resistance of an underlying layer of ash must be compensated for by increasing the air pressure if smoke is to be avoided.

Handling Local Fuels. Julian E Tobey, director of engineering, Upper Monongahela Valley Coal Bureau, in his paper "What Research Is Doing for Smoke Abatement," stated that the power engineer is responsible for seeing that manufacturer and design engineer provide apparatus that handles any and all solid fuels available locally. This means that the furnace must be able to burn several coals efficiently.

He described the many boiler and stoker designs now being studied for development, as well as a new air-coal flowmeter used with pulverized coal. Another highlight of his talk was the description of a new separator to remove flyash from the gas stream of a coal-burning gas turbine.

Tobey suggested that old plants be modernized or scrapped because a smoking plant usually has many other defects. Sometimes a complete overhaul helps. The furnace can then be redesigned to incorporate overfire air feed from either steam or high-pressure jets. Anyone interested in overfire air jets for stationary plants can obtain *Technical Report No. 7* from Bituminous Coal Research Association, 912 Oliver Bldg, Pittsburgh, Pa.



Frank Smart, chairman, completes a 2½ year job rewriting the constitution

Smoke Offenders. In "Smoke Abatement and the Problem in Cleveland," H B Lammers, director of engineering, Coal Producers Committee for Smoke Abatement, went contrary to most authorities in maintaining that residential consumers usually are not the greatest smoke producers. Studies by his committee show that only 5 to 10% of the difference in seasonal smoke pollution comes from domestic consumers. From 50 to 60% of the plants surveyed smoke because of indifference or carelessness of fireman or engineer.

In Lammer's opinion, laundries appear to be the worst power-plant smokers; process plants, such as steel mills and chemical plants, discharge large quantities of smoke and fumes to pollute the atmosphere. He suggested that power engineers clean up their plants and take the initiative in smoke elimination instead of waiting until community organizations press the passage of local ordinances.

Lammers explained how his committee functions after it is invited to survey the smoke situation in a community. Main job is to visit each individual plant, inspect boilers and firing equipment, determine furnace heat release, etc, so a practicable remedy can be prescribed for the plant. Prescribing a remedy and having it carried out, he finds, are two different matters.

Delegates to the convention should not overlook the opportunity to report favorably to their local chapters on the smoke-abatement work being planned by the national committee. Exchange of ideas through this central body and participation of power engineers in local civic affairs will make their opinions respected when it becomes necessary to pass and enforce smoke ordinances.

Election of Officers. At the final session the vice-president, George E Wills (page 99) was elected president for the year 1946-47. Elected as vice-president for the same term was Joseph P Flynn of Hillside, N. J., supervisor of ventilation and control for the Holland Tunnel Commission. Flynn has been active in NAPE for almost 30 years.

Other officers elected are: secretary, A F Thompson, Chicago, Ill.; treasurer, Harry J Harp, Manchester, N. H.; conductor, John Reilly, Meriden, Conn; doorkeeper, George Neal, St. Paul, Minn.; board of trustees, Clifton Harding, Kittery, Me.; L J Mamer, Evanston, Ill.; John Huckins, Los Angeles, Calif.; G M Diebold, Buffalo, N. Y.; board of arbitration, Carl Daubenmire, Columbus, Ohio; James Coe, New York, N. Y.; T R Herlihy, Los Angeles, Calif. Next year's convention will be held in Boston.

Between meetings delegates gather with others attending the convention on the auditorium steps for the official photo

GAS TURBINES

Model of proposed 10,000-kw Allis-Chalmers gas-turbine plant

By **L N ROWLEY,** *Managing Editor*
and **B G A SKROTZKI,** *Associate Editor*

With current rapid progress in development of gas-turbine plants, POWER recognizes a responsibility to its readers to keep them informed on the evolution of this new tool in the power-generation field. In addition to feature articles which periodically report gas-turbine progress, these 20 pages now summarize present and proposed cycles, component parts of machines built and planned, performance data and applications.

Within a brief ten years after the first practical gas turbine developed some usable net output, this new prime mover has already found application in aircraft, locomotive and ship drives as well as stationary power and process industries. Power engineers have an interest in the present development stages because gas turbines can do *some* jobs better than steam turbines and engines and internal-combustion engines.

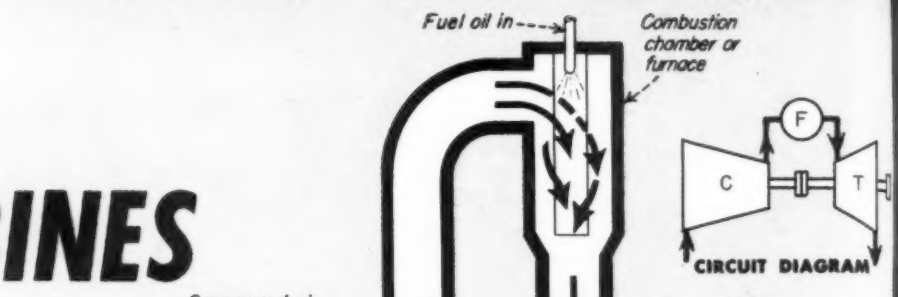
Because there are exciting prospects of bigger, better gas turbines, of greater efficiency, and less cost, the future of the gas cycle becomes brighter with each passing month. Adding to this the likelihood that gas turbines can be readily adapted to use atomic energy, we find there is every reason for engineers to study all phases such as cycle theory, construction and operating characteristics.

In general, gas turbines have fewer parts, weigh less and cost less to build than other prime movers. They require little auxiliary apparatus, can be built to use no water and have already proved their good behavior in respect to maintenance needs.

However, much development and research remains to be done before gas turbines can take their place alongside tried and proven steam and diesel plants. Such efforts are now being made by many groups.

Able suggestions and criticisms by gas-turbine design and application engineers helped in the writing of this article and their cooperation is warmly acknowledged.

HOW GAS TURBINES WORK



Simple gas-turbine plant consists of three principal pieces of equipment: (1) *compressor* which raises pressure of atmospheric air and discharges it to (2) *combustion chamber* or *furnace* where burning of fuel raises air temperature before it enters (3) *turbine* through which the heated gas expands and does work on the turbine blades. Major part of turbine output goes to drive compressor; remainder is available power

The simplest form of gas-turbine plant, illustrated above, consists of a *compressor*, a *combustion chamber*, and a *turbine*. The compressor takes in atmospheric air and raises its pressure. In the combustion chamber, fuel burns in this compressed air, raising its temperature and increasing its heat energy. This produces a *working fluid* that can be expanded in the turbine to develop mechanical energy, just as the expansion of steam does in the more familiar steam turbine. Part of the gas turbine's energy output goes to drive the compressor and the remainder is available as useful work. The fact that the working fluid is a gas gives the gas turbine its name; there is no connection with the fuel burned, which may be liquid, gaseous, or, possibly, solid.

STEPS IN CYCLE

To know how gas turbines behave requires a clear understanding of the various steps in the cycle. Because the only known way to make a heated fluid produce mechanical energy is to allow it to expand from a higher pressure to a lower one in an engine or turbine, we must start with a compressor to create needed higher pressure.

It is conceivable that expansion of compressed air in the turbine could generate enough energy to drive the compressor and the machines could operate without burning fuel in a combustion chamber. But both turbine and compressor are less than 100% efficient and hence turbine output cannot match compressor load because of the losses incurred in compression and expansion. In any case, there is no profit in a machine that merely drives itself. Thus supplying heat energy in the combustion chamber is necessary to make up for losses in the system and to make some useful energy available.

The problem thus becomes the familiar one of making as much useful energy as possible from as little fuel. Since part of the fuel burned goes to make up losses, principally in the compressor and turbine, the first step is to design these machines for highest possible efficiency. Tremendous strides have been made since early gas-turbine plants failed for lack of high-efficiency machines, but we have now reached an efficiency level from which further advances must needs be slow.

What remains then? Perhaps the most promising way to boost over-all efficiency is to increase throttle temperature. We can do this by continuing to burn the same amount of fuel while decreasing the air flow. Let's assume that this is done in such a way that, while mass of gas flowing through the turbine is less, increase in temperature is enough to keep total energy the same. Turbine output thus remains constant but, with less air flow, compressor needs to do less work and hence we have a greater proportion of tur-

DEFINITIONS

Air rate: Pounds of air entering compressor inlet per unit of cycle net output.

Compression efficiency: Ratio of work required for ideal adiabatic air compression through a given pressure range to work actually needed by the compressor.

Engine efficiency: Ratio of work actually developed by turbine expanding hot gas through a given pressure range to work that would be yielded for ideal adiabatic expansion.

Machine efficiency: Term used to designate jointly compression and engine efficiencies of compressor and turbine.

Pressure ratio: Ratio of cycle's highest air pressure to its lowest pressure, usually *highest-pressure-compressor discharge* to the *lowest-pressure-compressor inlet*.

Thermal efficiency: Percentage of total fuel energy input appearing as net cycle work output.

Work ratio: Ratio of cycle net work output to the total work developed in the turbine or turbines.

bine output available as useful power.

Throttle temperature is limited by the fact that metal parts exposed to the gas cannot be heated beyond their ability to retain their strength and other structural properties. With today's materials, and suitable design, 1200 F is considered a safe temperature for commercial long-life machines; 1350 F is the highest level yet attempted without some means of cooling.

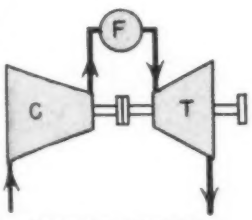
What will this simple gas turbine do in the way of efficiency in this temperature range? Depending on design, between 18 and 20%. For a plant that is extremely simple, requires no cooling water, and may be made highly compact and light in weight, this efficiency offers attractive possibilities. Nevertheless, metallurgists seek continuously for materials to withstand higher temperatures needed for higher efficiencies.

At the same time, designers turn to other ways of boosting efficiency. Thus we find use of air cooling, and other schemes, to permit operation at higher temperatures without overheating stressed metals. And, as has been the case in steam plants, higher efficiency can be obtained by more complex hookups, utilizing various efficiency-improving devices. For example, turbine exhaust can be passed through a heat exchanger (*regenerator*) to preheat air going from compressor to combustion chamber. Thus waste heat does some of the temperature-raising job and less fuel need be burned.

In compressor work it is common practice to divide compression into two or more stages and to cool the air between them. Such *intercooling* removes part or all of the heat of compression, reducing volume of air to be handled in the succeeding stage. This, in turn, decreases compression work, permitting a smaller compressor with less power consumption. The same scheme may be applied to a gas-turbine plant. Under suitable conditions, it improves over-all efficiency; it may be employed for the compressor benefits alone.

Expansion in the turbine may also be divided into a number of steps and the gas *reheated* between. This permits doing more of the expansion at high temperature and usually improves over-all efficiency.

It is apparent that there is no lack of ways to raise gas-turbine efficiency; the problem in most cases is to determine the combination of efficiency-increasing steps that produces the most economical answer to the demands of a particular application. In the following pages, discussion of practical gas-turbine plants will show how designers have worked out a variety of solutions to this problem, and how they have developed modifications of the basic gas-turbine plant, such as the closed, semiclosed, and power-gas cycles.



SIMPLE CYCLE

FIVE PATHS TO HIGHER GAS-TURBINE-PLANT EFFICIENCIES

With today's machines and materials, the simplest gas-turbine plant, consisting of compressor, combustion chamber and turbine, is good for 18-20% efficiency. Five basic paths to higher efficiencies are available to the designer: two involve no change in equipment required but face existing design and materials limitations; three require additional equipment and hence face economic limitations. Which method, or combination of methods, is used depends on type of application

Efficiency can be increased without added complication by:

IMPROVING MACHINE EFFICIENCY

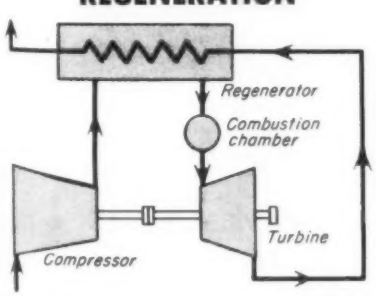
Efficiency of compressors and turbines sharply affects over-all plant performance. These units have reached high levels of efficiency and thus this path offers necessarily limited prospects for the future

RAISING THROTTLE TEMPERATURE

Biggest potential efficiency increase lies in higher throttle temperature, which necessitates improved materials and designs that permit raising gas temperature without overheating stressed metal parts

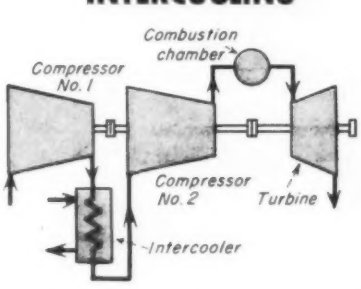
Efficiency can be increased without exceeding existing limitations of machine performance and materials, but at the cost of increased plant complexity, by:

REGENERATION



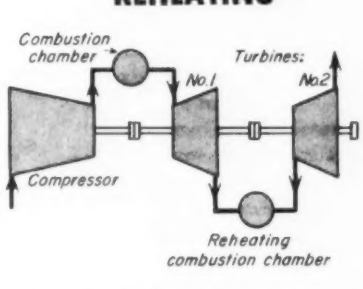
Regeneration recovers heat in turbine's exhaust to raise the air temperature and hence reduce amount of heat added by burning fuel. Resulting increase in over-all efficiency must be balanced against the cost of adding heat-transfer surface

INTERCOOLING



By cooling air at an intermediate point, or points, during compression, amount of compressor work is cut and compressors can be smaller. Gain in over-all efficiency usually results, but intercooling may be used for compressor benefit alone

REHEATING



Under suitable conditions, plant efficiency can also be increased by dividing turbine expansion into two or more steps and reheating the gas between each. By this means a greater amount of the expansion is accomplished at high temperature

PLANT HOOKUPS

Thus far we have dealt with gas turbines that operate with compressors taking suction from the atmosphere and turbines exhausting to it. This is called an *open-cycle* plant. The great majority of plants thus far designed and built are of this basic type, with working elements arranged to meet the efficiency and general requirements of their service.

The simplest form of plant, with only compressor, combustion chamber and turbine, can be extremely light in weight and compact, hence it finds universal application in aircraft. This same simplicity, reflected in lower first cost, makes this type suitable for other jobs, standby and peak-load plants for example. The first stationary gas-turbine plant, a Brown Boveri 4000-kw emergency plant at Neuchatel, Switzerland, operates without a regenerator, showing 18% shaft efficiency at 1025 F throttle temperature. Units of the same capacity and cycle layout are now being built by Brown Boveri for Chimbote, Peru and for Iran.

The 2000-hp experimental unit built by Westinghouse, Fig. 1, shows influence of their aircraft experience. Straight-line layout of compressor, multiple combustion chambers and turbine practically eliminates piping and cuts pressure losses. Operating at 9000 rpm and 1350 F, highest temperature yet attempted without air cooling, its efficiency is estimated at 20%. Over-all length is 26 ft 3 in., width 3 ft 6 in., and height 6 ft.

We have seen the gains made possible by adding heat recovery to the simple cycle. Fig. 2 shows a single-shaft plant employing regeneration. Brown Boveri is now building four units of this general layout, for power generation; efficiency will be in the range from 23 to 26%. An experimental unit built by Parsons in England also follows this cycle.

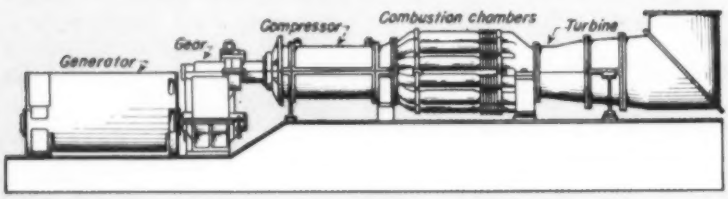
Addition of intercoolers and reheaters for higher efficiency fits in well with a 2-shaft arrangement, which offers control flexibility and other mechanical advantages. This permits operating one turbine at constant speed and the other at variable speed for better part-load efficiency (see p 95). Fig. 3 shows the 2-shaft machine built by Brown Boveri for a standby plant at Bucharest. Without regenerator, and operating at 1112 F, it shows efficiencies of 23% at full load, 21% at ¾, 17% at ½ and 10% at ¼. This set can go from cold to full speed in 4 minutes.

AIR-COOLED ARRANGEMENTS

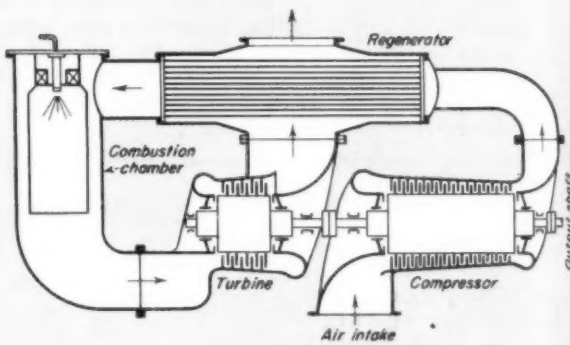
Air cooling of first-stage disks and use of impulse blading for a large temperature drop in fixed nozzles where stress is low characterizes the unit built by Allis-Chalmers for the U. S. Naval Experiment Station at Annapolis, which operates at 1500 F, highest temperature yet reached for a long-life machine. Its two-shaft arrangement, with output and com-

TYPICAL OPEN-CYCLE PLANT DESIGNS SHOW WIDE VARIETY OF HOOKUPS

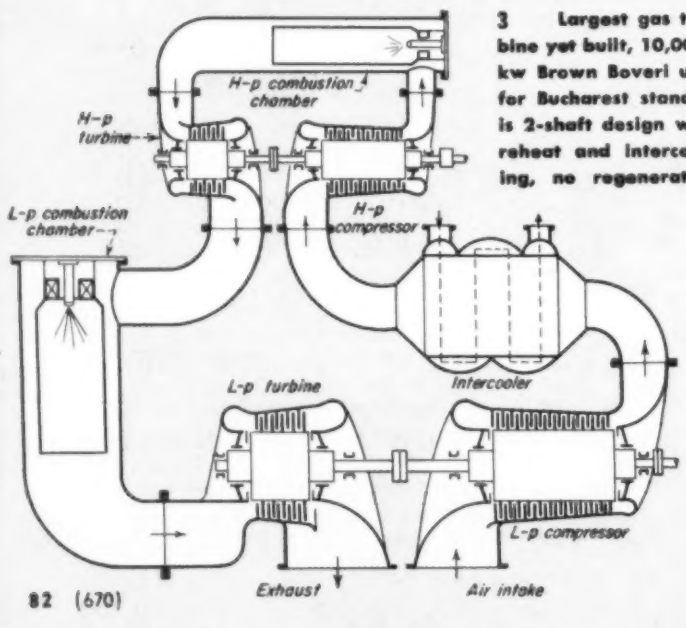
Open-cycle plants built and building range from simplest possible combination of elements to 2- and 3-shaft designs using efficiency-increasing devices. Hookup depends largely on plant size and application type



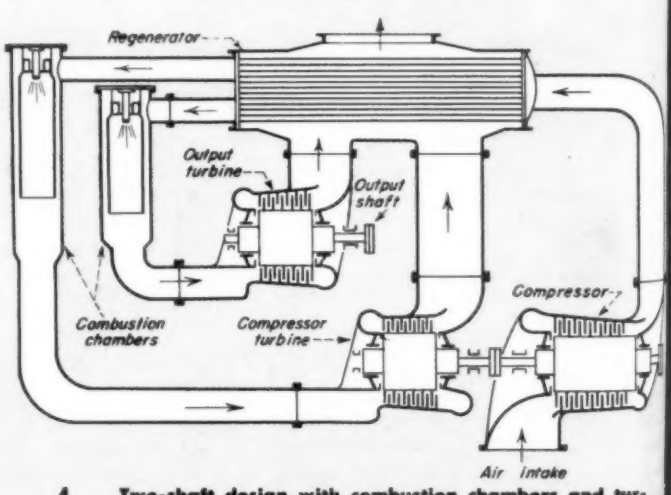
1 Extreme simplicity marks 2000-hp Westinghouse unit; straight-line layout of compressor, combustion chambers and turbine saves piping and pressure drop. Turbine operates at 1350 F, without air cooling



2 Single-shaft hookup with regenerator is used in Brown Boveri units being built for South America (3 at 1650 kw) and Alexandria, Egypt (one at 1200 kw)



3 Largest gas turbine yet built, 10,000-kw Brown Boveri unit for Bucharest standby is 2-shaft design with reheat and intercooling, no regeneration



4 Two-shaft design with combustion chambers and turbines in parallel used in Allis-Chalmers Annapolis experimental unit facilitates testing various elements independently

pressor turbines and their respective combustion chambers in parallel, facilitates testing each element.

The 2500-hp gas-turbine plant built for the Navy by Elliott Co follows the 2-shaft design, with one intercooler and one reheater. Operating at about 1250 F, and with a regenerator of 75% effectiveness, it tested at 29.5%.

Another 10,000-kw unit under construction at Brown Boveri for Lima, Peru, differs from the Bucharest machine in the addition of a regenerator and another intercooler, Fig. 6. It will be used for power generation, hence higher efficiency is desirable. Brown Boveri recently received orders for a 13,000 and a 27,000-kw unit for a plant to supply power in winter months in Switzerland.

The unit of Fig. 7, a 750-hp experimental set under design by DeLaval, employs a 3-shaft arrangement to provide reversing. There are two compressors, with intercooling, a regenerator, and three turbines, with reheat. High-pressure turbine operates at 1500 F; cooling air from turbine wheel goes to the following combustion chamber as the combustion air supply.

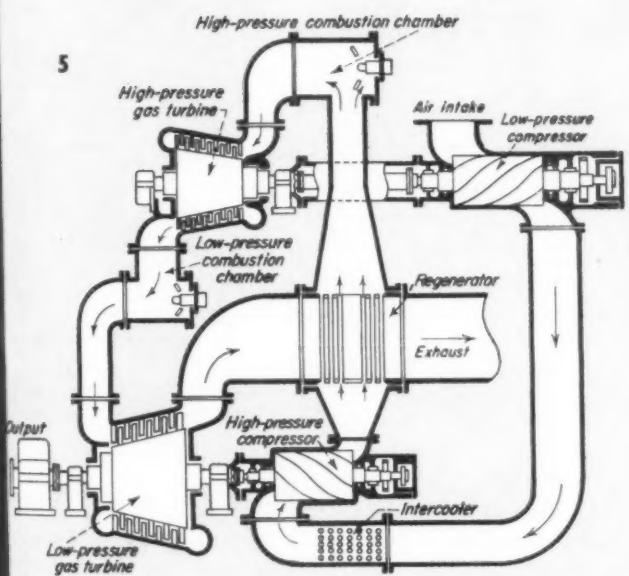
The low-pressure turbine, on a separate shaft, provides ahead power, being connected through clutch and gearing to propeller shaft. Under this condition, intermediate-pressure turbine is declutched and drives only its own compressor. For astern operation, the low-pressure turbine is bypassed and declutched and the intermediate-pressure turbine, which operates with reverse rotation, is connected to the shaft by clutch and gearing. Additional energy resulting from greater pressure drop through intermediate unit provides power to drive both compressor and shaft.

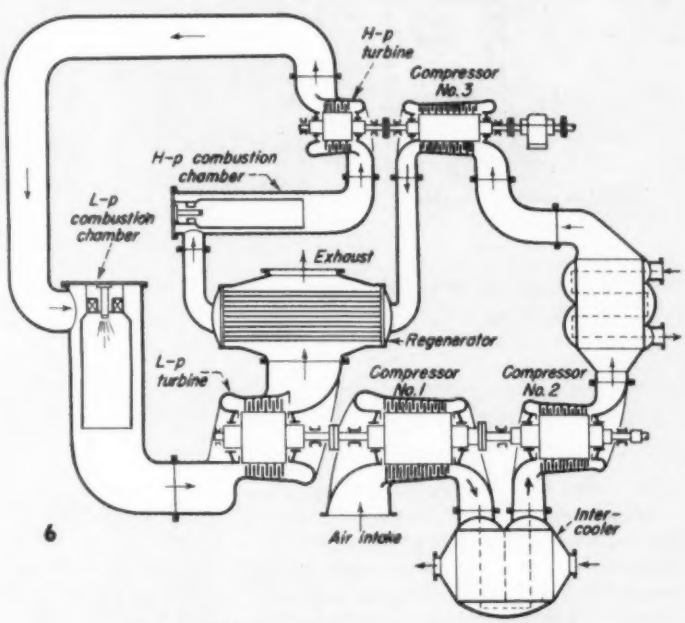
CLOSED-CYCLE PLANTS

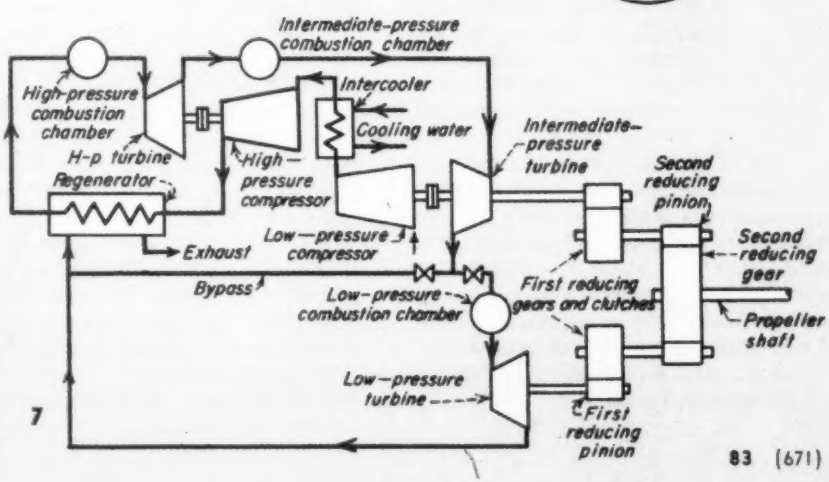
The *closed-cycle* plant differs from the open cycle in that air is recirculated. The diagrams of Fig. 8 show how this is done. Air is heated indirectly in an *air heater,* corresponding to the boiler in a steam plant. Thus the air is heated without contamination by combustion products. It expands through the turbine in the usual fashion and then passes to a *precooler,* corresponding to a condenser in a steam plant. This restores air to original temperature before it enters the compressor to repeat the cycle. Closed-cycle performance follows that of open cycle and the practical results of such steps as regeneration, reheating and intercooling are essentially the same. Use of gases other than air as a working fluid offers certain advantages in specific output and efficiency.

Most of the advantages seen in the closed cycle grow out of the fact that it operates at pressures above atmospheric. For example, pressure at compressor inlet might be 80 psi instead of atmospheric. Now it is characteristic of gas-turbine plants that for each temperature and machine efficiency there is one best pressure ratio. Let's say that it's 5.0. Then with the closed cycle, top pressure would be 400 psi instead of about 75 psi in an open cycle.

These higher pressures mean higher air density and smaller volume, hence smaller dimensions for turbines, compressors, etc. In turn, smaller dimensions for a given output permit higher







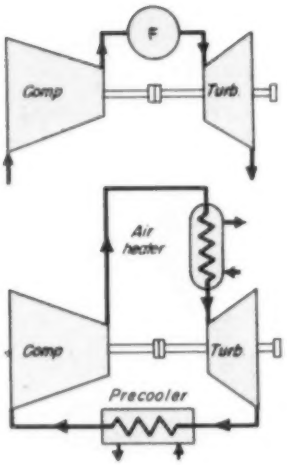
5 Unit built for Navy by Elliott is of 2-shaft design with intercooling, reheat and regeneration

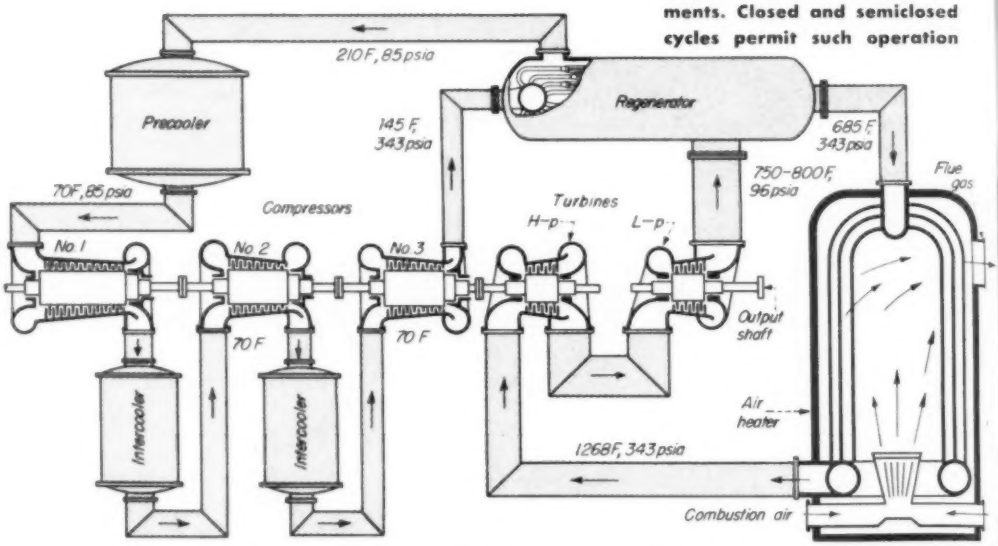
6 Unit under construction by Brown Boveri, rated 10,000 kw, will generate power at Lima, Peru. Regeneration, additional intercooling stage, give higher efficiency desirable for this application

7 Proposed arrangement of 3-shaft plant by DeLaval provides reversing. In ahead operation, i-p turbine is declutched, driving its compressor only, and all output comes from i-p turbine. For astern drive, i-p unit is bypassed and declutched; i-p turbine, which operates in reverse rotation, is clutched. Larger pressure drop available provides power enough for i-p turbine to drive the shaft

CLOSED- AND SEMICLOSED-CYCLE PLANT HOOKUPS

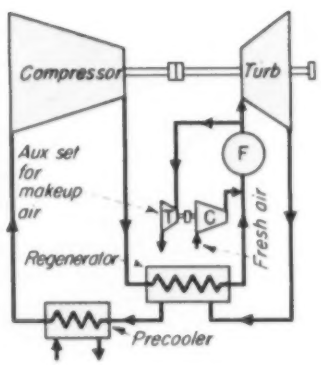
Operation at higher pressure throughout cycle means more-dense air, hence smaller elements. Closed and semiclosed cycles permit such operation

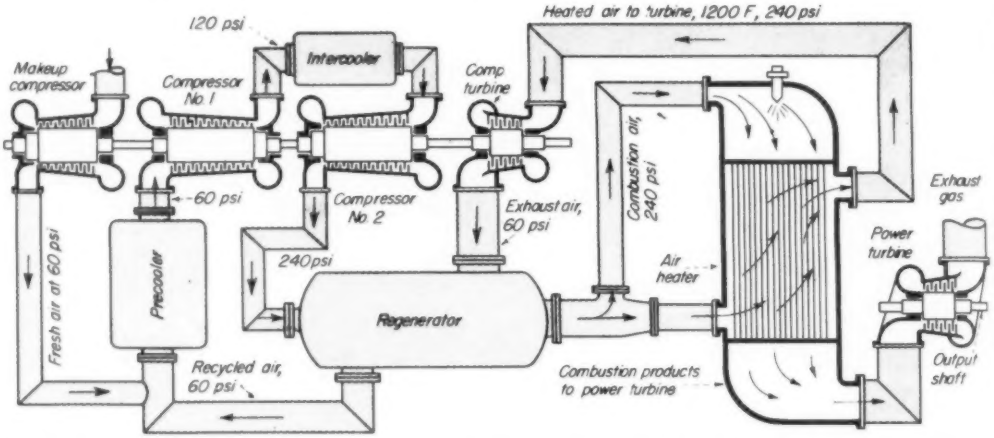




8 As shown above, closed cycle differs from open in that air is recirculated, being heated indirectly and cooled before return to compressor. This permits operation at much higher pressure

9 Experimental 2000-kw closed-cycle plant of Escher Wyss employs three compressors, with intercooling, regenerator, and two turbines, without reheating. Note air heater and precooler





10 In Westinghouse semiclosed proposal, fuel burns directly in circuit; auxiliary compressor supplies fresh air for combustion; gas withdrawn to balance system powers small charging turbine

11 In 7000-hp marine semiclosed plant by Sulzer, compressors and drive turbine form a closed cycle handling air only; combustion gas from indirect-direct heater goes to output turbine

temperatures without exceeding conservative stress limits. High density also improves heat-transfer coefficients and this, coupled with smaller volume, makes for substantial reductions in size and weight of heat exchangers. Freedom from fouling, because only clean air circulates, makes high velocities and small tube diameters practical, for further gains in size and weight. Fuel flexibility is obvious.

Plant output may be changed by raising or lowering working-medium density; this does not change temperatures and hence gives good part-load efficiency. With essentially constant volume-flow conditions, turbine and compressor blading may be designed for best-point performance rather than average.

On the other hand, the closed cycle requires two additional elements, an air heater and precooler. Air heater efficiency can be made quite high, of the order of 90%, and pressure combustion plus ingenious design may produce a compact unit. Nevertheless, need for an air heater represents addition of an element of considerable size and cost. Furthermore, precooling, although it may be done with air, normally requires cooling water, but large air-water temperature difference reduces amount to a fraction of that needed for a comparable steam plant.

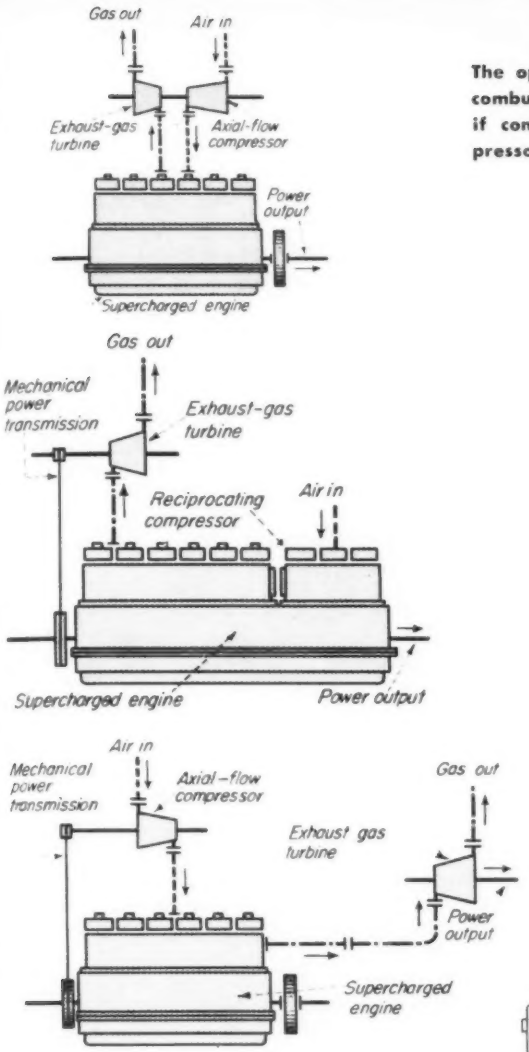
Fig. 9 is the hookup of a 2000-kw test plant built by Escher Wyss for closed-cycle operation. At 1268 F, with a pressure ratio of about 4.0 (85 to 343 psia) this plant showed an efficiency of 31.5% at full load and about 25% at ¼ load. Escher Wyss is now building a 12,500-kw plant (see POWER, Aug 1946, p 90) and designs have been proposed for 25,000 to 100,000-kw units (see p 98 and POWER, Nov 1945, pp 66, 67). Efficiencies of 36-37% are projected.

SEMICLOSED CYCLES

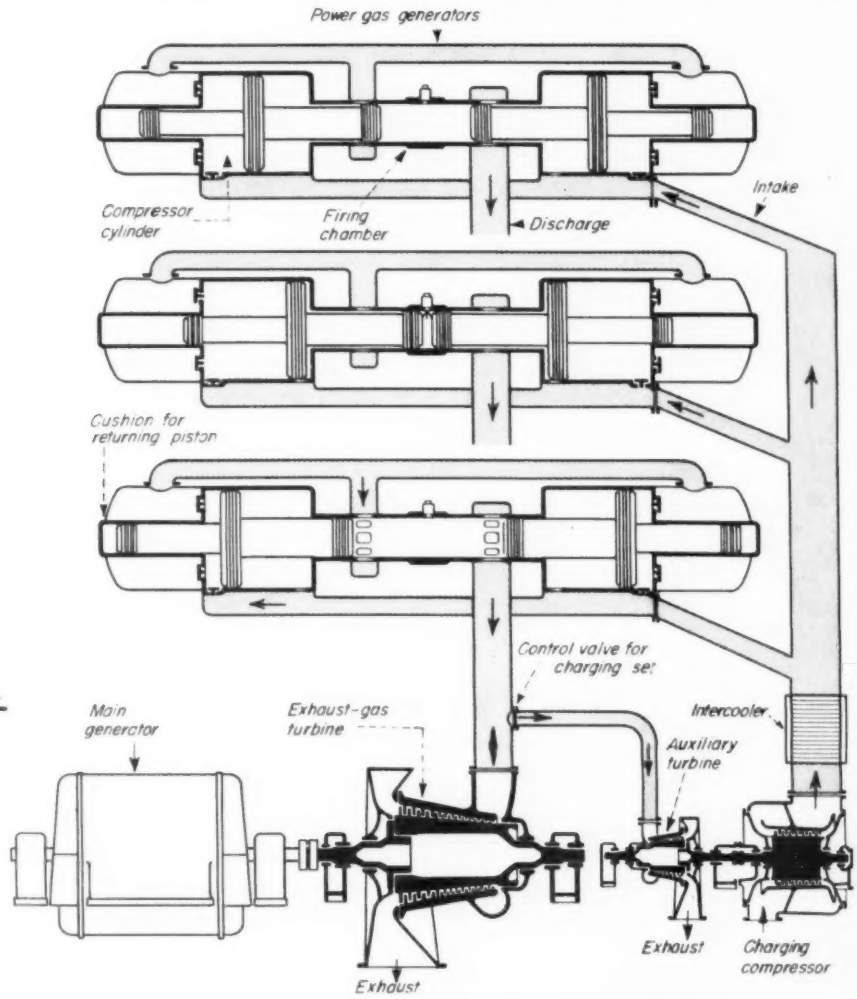
A *semiclosed* cycle was proposed by Westinghouse engineers in 1944. As shown in Fig. 10, fuel is burned directly in the circuit, instead of indirectly as in the closed cycle. Supply of fresh air needed for combustion comes from an auxiliary compressor driven by a small turbine that operates on gas drawn from the main cycle to offset effect of adding com-

POWER-GAS OR FREE-PISTON-COMPRESSOR CYCLE

The open, closed and semiclosed cycles mentioned thus far all operate on continuous-combustion principle. Higher temperatures can be employed without harm to materials if combustion is intermittent, as in a diesel engine. Power-gas or free-piston compressor cycle works on this principle, offering potentially high thermal efficiency



12 Starting at top, diagrams show evolution of power-gas cycle from conventional 4-cycle supercharging, through hookup necessary to supercharge 2-cycle diesel, to scheme in which engine-driven compressor absorbs all engine output for supercharging; turbine makes net power



13 In 7000-hp power-gas-cycle-unit by Sulzer, three gas generators supply one output turbine. A precompressor, driven by auxiliary turbine, handles low-pressure large-volume compression efficiently, increasing power-gas capacity

bustion air. Pressures of 150 and 600 psi were suggested. Direct firing eliminates the air heater but fuel flexibility is lost; high-pressure operation makes size savings.

A semiclosed plant of different design has been built by Sulzer Bros, Fig. 11. This 7000-hp unit may be considered as a closed and open cycle interconnected. The closed cycle, handling clean air, comprises two compressors and their drive turbine, a regenerator and a precooler. Fresh air enters the system from an auxiliary compressor, just ahead of the precooler. The heater combines direct and indirect firing. Fuel is burned in air drawn from the cycle just ahead of the heater; combustion products pass through tubes, giving up heat to clean air flowing over the tubes. Clean air supplies the compressor-drive turbine; combustion products power the separate output turbine, which exhausts to atmosphere. Both turbines operate at 1200 F; cycle pressures are 60 and 240 psi.

POWER-GAS CYCLES

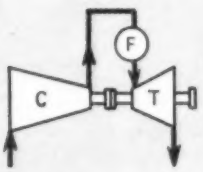
Development of the power-gas cycle grew out of work at Sulzer Bros on high supercharging for 2-cycle engines. The supercharging of 4-cycle engines with an exhaust-turbine blower, top, Fig. 12, is familiar. This will not work on 2-cycle engines because at low engine speeds air supply is insufficient. This leads to connecting the compressor and exhaust turbine to the engine mechanically; net output of combination is engine plus turbine output minus compressor load. If supercharging pressure is increased, a point is reached where all engine output goes to drive compressor, and the exhaust turbine, supplying sole net output, can be cut free without disturbing energy balance. The engine-compressor combination thus acts as a power-gas generator for the turbine, taking the place of the compressor and combustion chamber.

For this service the free-piston compressor proves advantageous. Fig. 13 shows diagrammatically a 7000-hp plant built by Sulzer employing three free-piston power-gas generators to supply a single output turbine. Various studies indicate that efficiencies of 45 to 50% may be possible.

GAS-TURBINE PERFORMANCE

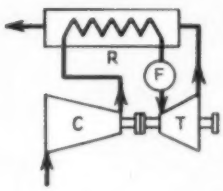
Here are basic cycles with theoretical performance curves plotted below. Zero miscellaneous losses assumed. Inlet-air temperature = 60F

SIMPLE CYCLE



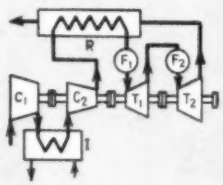
Inlet-gas temperature: ——— 1500F ---- 1000F Equal machine efficiencies

REGENERATIVE CYCLE



Compression and engine efficiencies equal to 85%. Regenerator eff = 70%

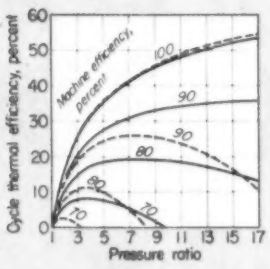
REHEATING AND INTERCOOLING

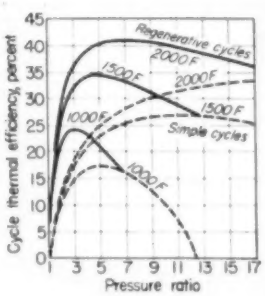


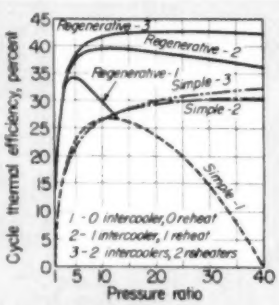
1500 F temp; 85% machine eff; 70% regen eff

Open and closed cycles of same arrangement perform alike when miscellaneous losses are zero. Cycle pressure ratio controls performance for given air and gas temperatures, efficiencies and cycle equipment layout

THERMAL EFFICIENCY

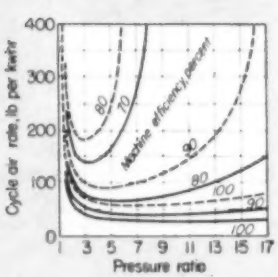


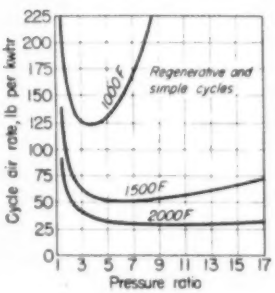


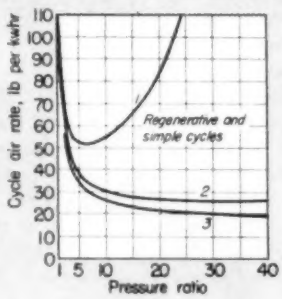


For any set of conditions thermal efficiency rises to an optimum value and then falls to zero with an increasing pressure ratio. Higher gas temperatures must be accompanied by higher pressure ratios to reach the optimum cycle thermal efficiency

AIR RATE

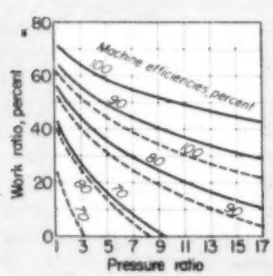


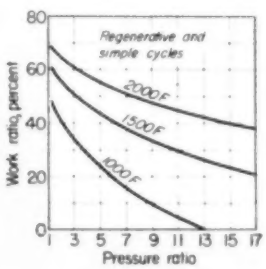


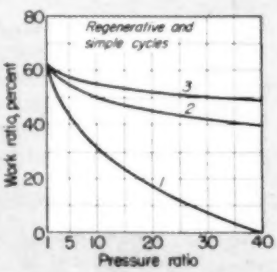


Optimum air rate occurs at somewhat different pressure ratio than optimum thermal efficiency. Factors increasing the latter simultaneously decrease air rate. Regenerator however, does not materially affect the cycle air rate

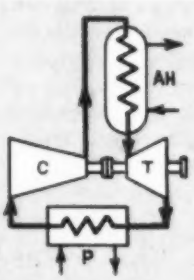
WORK RATIO

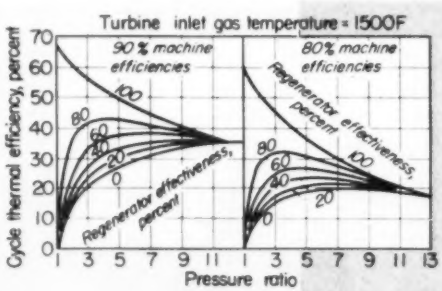






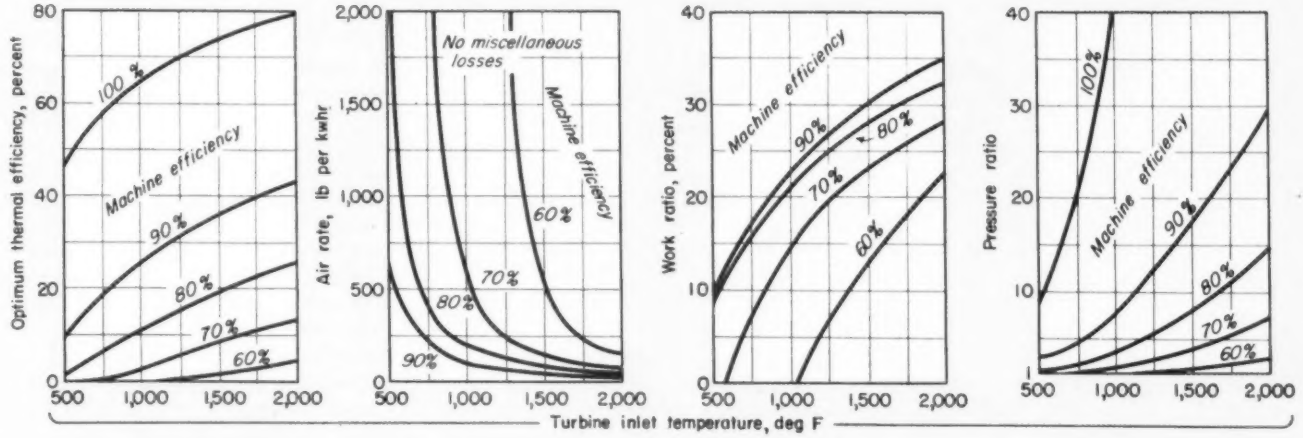
Pressure ratio increase always reduces proportion of turbine work available for net output. Factors reducing air rate increase work ratio at any given pressure ratio. Regenerator again has no material effect on work ratio





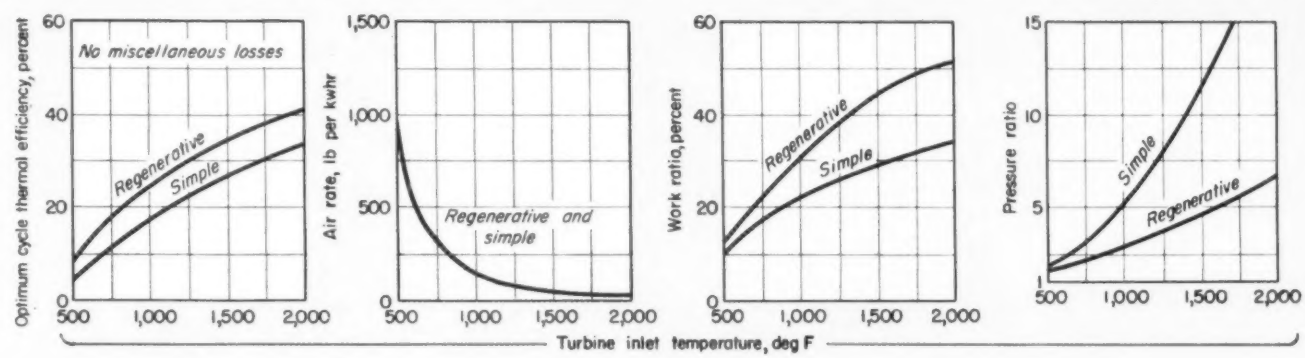
Regenerators are useful in reducing amount of fuel required to produce a given net output and so increasing cycle thermal efficiency. Savings realized depend on amount of heat-transfer surface provided and turbine-exhaust-gas temperature. Increasing regenerator effectiveness causes optimum thermal efficiency to occur at lower pressure ratios but has no effect on air rate or work ratio if no pressure losses concurrently appear in cycle

CHARTS BASED ON CALCULATIONS BY POWER EDITORS SHOW EFFECT OF DIFFERENT OPERATING VARIABLES ON CYCLE PERFORMANCE



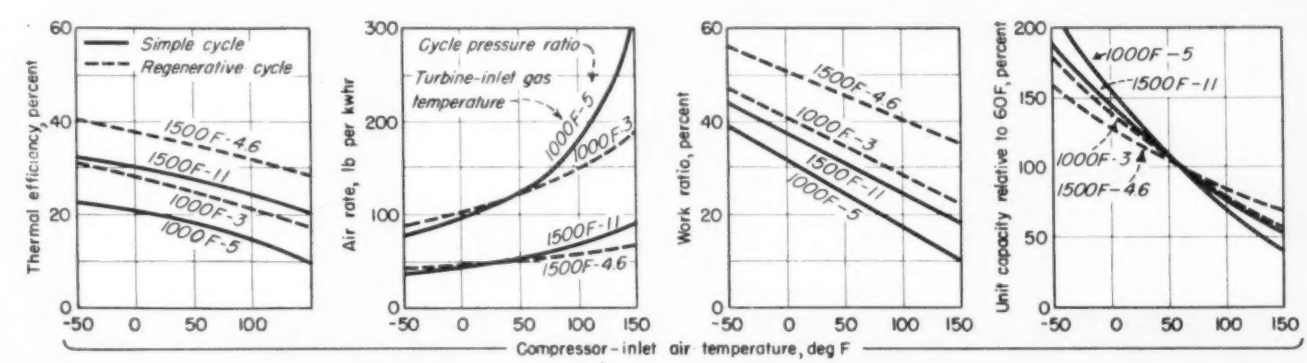
SIMPLE-CYCLE PERFORMANCE VARIATION WITH TURBINE-INLET TEMPERATURE AND MACHINE EFFICIENCIES

These performance curves for the simple-cycle gas turbine are based on compressor-inlet air temperature of 60 F and equal compression and engine efficiencies. Values of air rate, work ratio and pressure ratio correspond to optimum thermal efficiency plotted in the first graph. Note high order of machine efficiency required to make cycle workable even with high gas temperatures. Present cycles approximate 85% or better in machine efficiencies. Some experimental cycles are designed to operate at 1500 F. Designers seriously plan for 2000 F but wait for further metallurgical developments to aid realization



COMPARISON OF SIMPLE- AND REGENERATIVE-CYCLE PERFORMANCE VARIATIONS

These curves show how performance factors vary for both simple and regenerative cycles having 60 F compressor-inlet temperature, 85% machine efficiencies and a 70% effective regenerator for the latter. Regenerative cycle operates at higher thermal efficiencies for all turbine-inlet temperatures. Though simple and regenerative cycle air rates are not exactly equal they are so close that in the scale plotted they may be represented by a single curve. Regenerative-cycle work ratios are higher than those of simple cycle because pressure ratios are lower. Values correspond to thermal efficiency in first graph



PERFORMANCE VARIATION WITH COMPRESSOR-INLET AIR TEMPERATURE

Air temperature entering the compressor inlet has a marked effect on gas-turbine cycle performance. Lower temperatures improve operation by increasing thermal efficiency, decreasing air rate and raising work ratio. An important condition shown in the last graph indicates that any given machine designed for a given capacity at 60 F will gain in capacity with lower temperatures and vice versa. These curves are based on constant compression efficiency for all temperatures. Since any compressor will fall off in efficiency when operating at other than design conditions, capacity change will be less than shown and actual curves will be more nearly horizontal. Air rate and the changing air density both influence total cycle capacity.

CONSTRUCTION DETAILS

Having covered in preceding pages the general layout and performance of gas-turbine plants, let's take a look at each of the pieces of equipment comprising such a plant. Many of the items resemble equipment with which we are familiar—turbines, compressors, heat exchangers—but there are some differences. These arise because the gas-turbine plant operates with gas as a working fluid and, perhaps even more important, because it must run at high temperature and efficiency to be commercially attractive.

General principles of steam-turbine design and operation, as presented in POWER, Dec. 1945, pp 64-67, apply to gas turbines as well; differences in construction grow out of differences in working fluid and operating conditions. In contrast to steam turbines, gas turbines have relatively few stages, because they operate on smaller pressure drops. Larger volume flow leads to more satisfactory stage proportions. Normally, no control valves, partial-admission arrangements or bypasses are necessary.

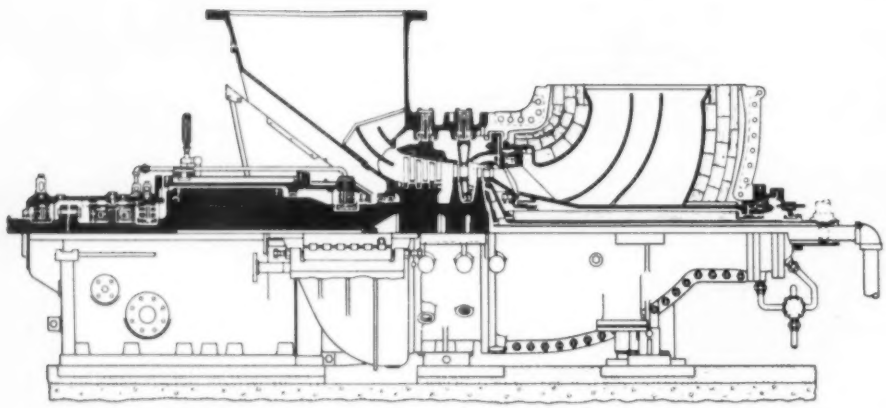
TURBINE CONSTRUCTION

Blades have been made by forging, machining from rolled bar stock and shapes, and by precision casting. Machining offers simplified metallurgical control and cost savings, but may mean compromising on shape. Forging permits any desired shape but the difficulty in high-temperature work can be gaged by remembering that the same metal that must deform readily at forging temperature must resist deformation at gas-turbine operating temperature, not much lower. With development of improved metallurgical control, casting may offer a solution for extremely high temperatures.

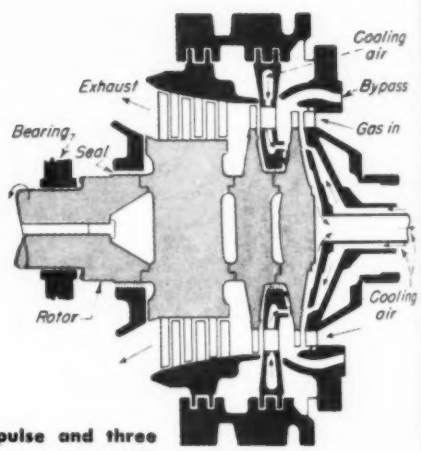
Turbine rotors and disks present a serious problem; large forgings of heat-resisting alloys cannot yet be produced dependably. This has led to use of various forms of built-up rotors comprising disks welded together according to a variety of designs. For example, the Elliott turbine, Fig. 4, has a hollow rotor fabricated from cross-rolled plate; the first disk is shrunk on the forged stub shaft and welded, and each succeeding disk is installed in the same manner.

Turbine casings offer no major dif-

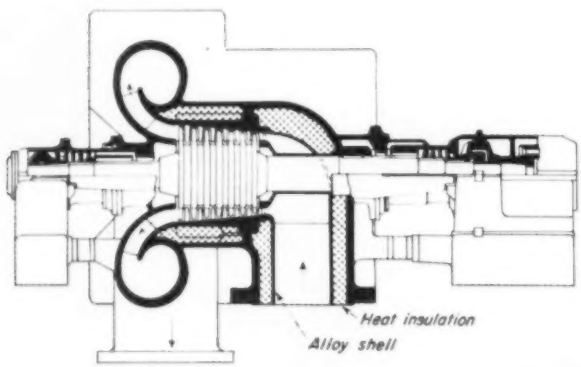
GAS-TURBINE DESIGNS REFLECT NEED FOR OPERATION AT HIGH TEMPERATURE



1 Turbine of 3500-hp Allis-Chalmers plant at U.S. Naval Experiment Station operates at 5200 rpm, with gas at 1500 F, 56.5 psia

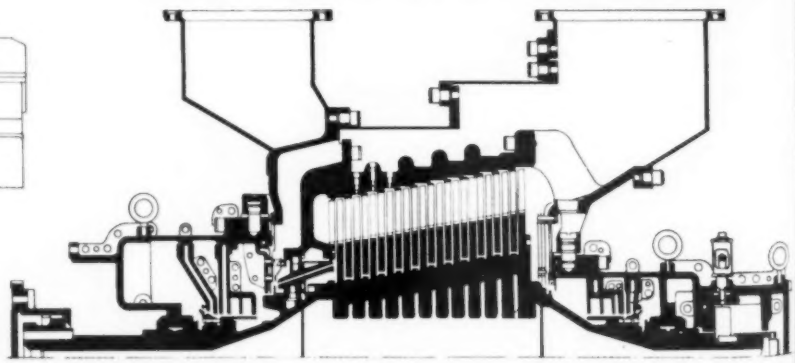


2 Detail shows two impulse and three reaction stages, starting bypass, air-cooling for both sides of the first-stage wheel



3 H-p turbine design for 25,000-kw 850-to-85-psi closed-cycle plant features a double casing. The rotor diameter is only 24 in.

4 Turbine of experimental 2500-hp Navy gas-turbine plant built by Elliott operates at 1250 F, 95.5 psia, 3720 rpm. Hollow rotor is fabricated from rolled-plate disks, carries 12 reaction stages



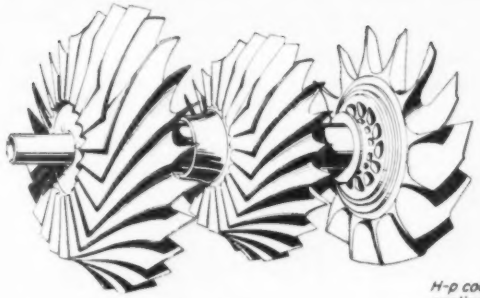
ficulties; forged or cast alloy sections are available and welded-plate construction is relatively simple. Fig. 3 shows an Escher Wyss design employing a double casing, which appears to be a satisfactory and economical solution. In all designs there is an appreciation of the desirability of a high degree of casing symmetry.

PROVISIONS FOR EXPANSION

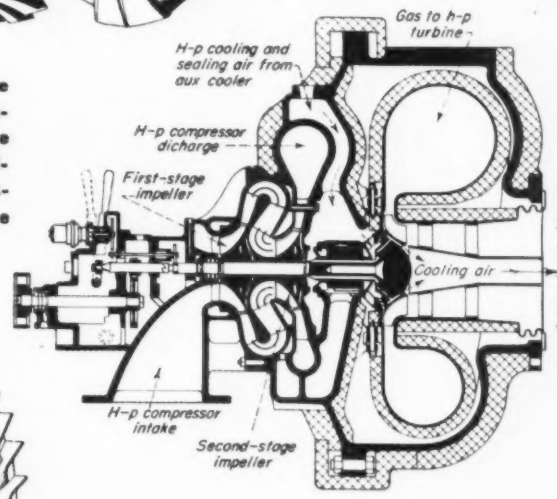
High rate of expansion with temperature rise characterizes many of the heat-resisting alloys, hence turbine designs must be able to take care of expansions up to ⅛ in. per ft. The unit of Fig. 4 has its various components supported on radial pins in such a way that correct centering is maintained while complete freedom for uniform radial expansion is allowed. To provide for axial expansions of the order of ½ in., a linkage supports one of the main bearings. The rotor of the Allis-Chalmers unit, Fig. 1, is overhung to eliminate the gland-sealing problem at the high-pressure high-temperature end of the casing.

Most multistage gas turbines employ reaction blading throughout, as in Fig. 4. Use of impulse staging permits taking a substantial pressure drop in fixed nozzles where stress is low; a net reduction in blade temperature is effected, although blade temperature stays higher than gas temperature. In a single-stage impulse turbine proposed by General Electric in 1944, blade temperature was estimated at about 1100 F for an inlet gas temperature of 1600 F.

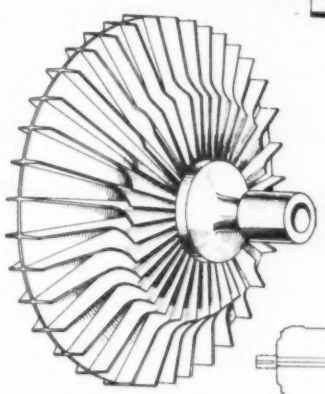
Previous references indicate the interest displayed in schemes for air-cooling stressed parts. The Allis-Chalmers experimental unit at An-



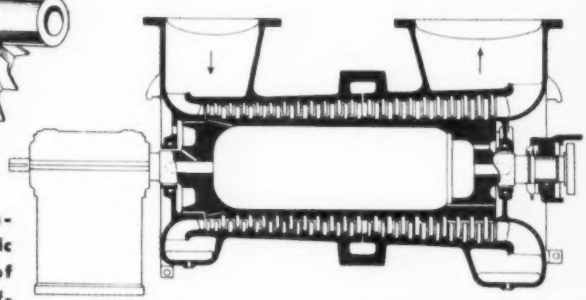
5 Birmann-bladed rotor of 2-stage-compressor and turbine element for DeLaval plant. Turbine wheel (right) has holes in hub for passage of cooling air



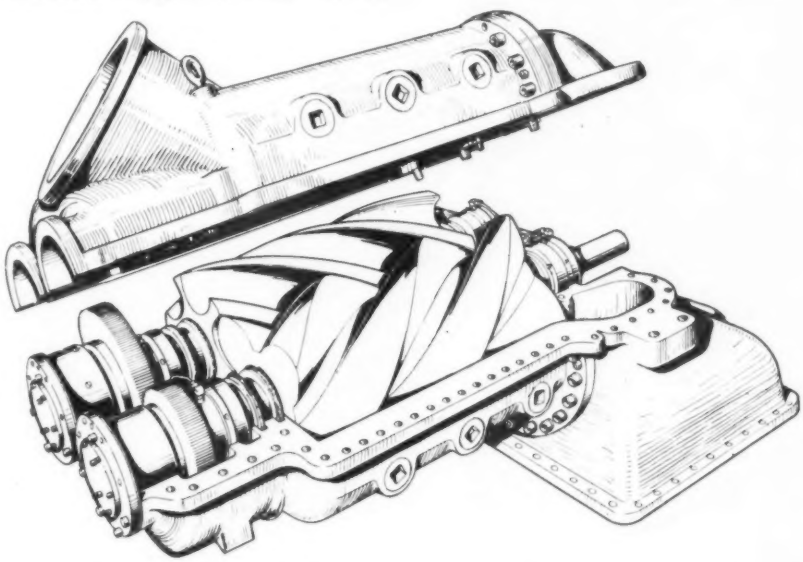
6 Cross-section of the DeLaval high-speed compresser and gas-turbine element for 1500 F. Cooling air supports combustion in following furnace



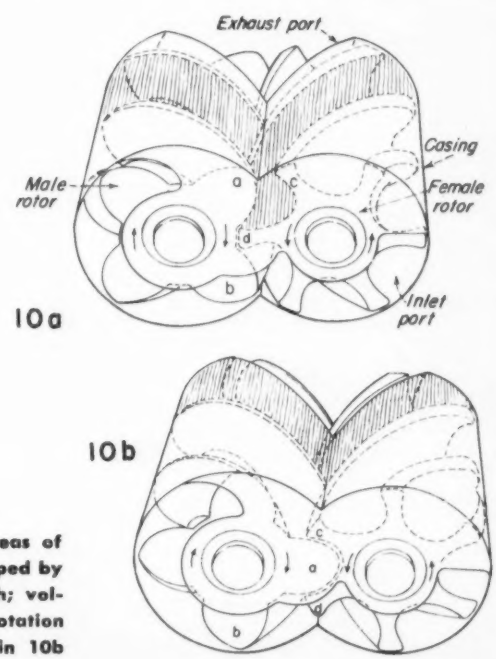
7 Double-suction impeller of General Electric jet engine is typical of high-efficiency centrifugals used in aircraft



8 Axial-flow compressor of 20 stages for Allis-Chalmers Annapolis unit. Efficiency of 85% is obtained at full load — 40,000 cfm at 45 psig head



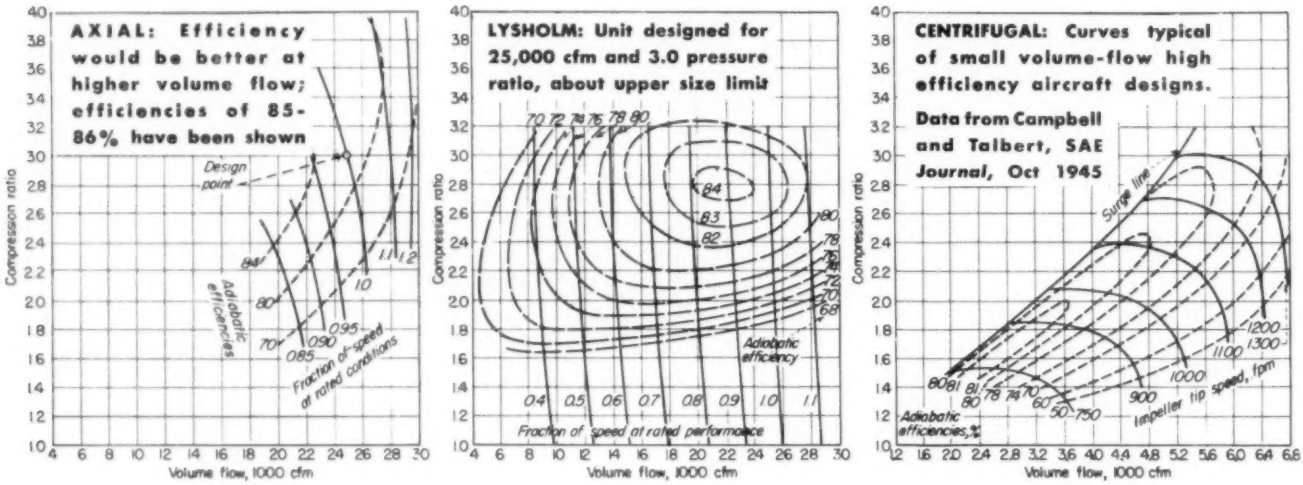
9 Lysholm compressor of Elliott's gas-turbine plant: gear-driven lobed rotors mesh without touching, raising air pressure by reducing volume. Intake hood is at lower right; discharge at upper left



10 Lysholm principle: shaded areas of 10a show two volumes of air trapped by each rotor as lobes start to mesh; volume reduction can be seen when rotation brings male rotor to full mesh, in 10b

TYPICAL PERFORMANCE CURVES SHOW COMPRESSOR OPERATING CHARACTERISTICS

11 General comparisons between compressor types must be made with caution because differences in size and design conditions influence performance. Curves below give a rough idea of operating characteristics: axial and Lysholm units are designed for similar conditions; centrifugal unit handles much smaller volume. Constant-adiabatic-efficiency lines are shown dashed


AXIAL: Efficiency would be better at higher volume flow; efficiencies of 85-86% have been shown
Design point
Adiabatic efficiencies
Fraction of speed at rated conditions
Compression ratio
Volume flow, 1000 cfm
LYSHOLM: Unit designed for 25,000 cfm and 3.0 pressure ratio, about upper size limit
Adiabatic efficiency
Fraction of speed at rated performance
Compression ratio
Volume flow, 1000 cfm
CENTRIFUGAL: Curves typical of small volume-flow high efficiency aircraft designs.
Data from Campbell and Talbert, SAE Journal, Oct 1945
Surge line
Impeller tip speed, fpm
Adiabatic efficiencies, %
Compression ratio
Volume flow, 1000 cfm

napolis, Fig. 1 and 2, employs both impulse staging and air cooling to effect a practical compromise between high gas temperature for thermal efficiency and blade and disk temperatures that will assure reasonably long life. This unit has two rows of impulse blading followed by three of reaction.

AIR-COOLING ARRANGEMENTS

To cool the highly-stressed first-stage wheel and blades, air at slightly above first-stage pressure is brought in through the annular space of a double-wall pipe. From here air flows through a series of holes just under first-stage nozzles and impinges on the first-stage wheel below the blades. Air flows over disk surface radially inward and exhausts to the center pipe. A positive-pressure blower circulates air; it is cooled for recirculation by external cooling apparatus.

From the same source, cooling air enters a belt surrounding the second-stage nozzles, flows through hollow nozzle vanes into an annular space below and then discharges against the downstream side of the first-stage disk. This air flow, which just about equals leakage past the diaphragm labyrinth seal, joins the gas stream, passing through the rest of the cycle.

Air cooling and other unusual features mark the turbine and compressor unit built by DeLaval and shown in section in Fig. 6. The turbine rotor, Fig. 5, shows the Birmann blading. Action of gas flow through this rotor may be likened roughly to water flow through the wheel of a francis hydraulic turbine. Gas flows through stationary nozzles distributed around the entire periphery of the wheel and enters the wheel tangentially. In the rotor, gas makes a 90-deg turn and exhausts from it in a direction parallel to the shaft. Gas flow through this turbine can be controlled by providing the nozzles with movable vanes (as in the gate of a hydraulic turbine). Nozzle openings can thus be varied from closed to full open, controlling direction and amount of gas entering the wheel without throttling losses.

Cooling air for the turbine wheel is bled from the compressor discharge and cooled before it enters a chamber surrounding the turbine bearing, adjacent to the wheel. From here air flows through channels in the wheel hub, leaving at the exhaust end after cooling the hub. Cooling air is kept separate from turbine exhaust gas in the concentric tube shown, Fig. 6, and serves as combustion air in the following reheating combustion chamber.

COMPRESSOR TYPES

Of the many types of air compressors, only three have thus far proved satisfactory for gas-turbine service, which requires highest possible efficiency in handling relatively large volumes at low compression ratios. Gas-turbine compressors should be inherently high-speed machines producing a continuous flow of oil-free air.

It might be said that the axial-flow compressor, with its high efficiency, made the commercial gas turbine possible and it is now used in virtually all non-aviation designs. In general mechanical layout, an axial-flow compressor resembles a turbine. Principal difference lies in blade contour. Instead of the turbine's typical crescent shape, compressor blading looks much like a section of a propeller. Design is such as to produce nearly straight axial flow through the machine.

LYSHOLM COMPRESSOR

The recently introduced Lysholm compressor is a rotary lobe machine which can compress air before discharging it, in contrast to the conventional lobe compressor which transports air into a region of higher pressure where it is compressed by back-flow effect. Fig. 9 shows a Lysholm unit with casing top half lifted. Lobes mesh accurately without touching, their relative positions being maintained by the driving gears. Air inlet hood is at lower right and discharge nozzle at upper left.

Fig. 10 illustrates Lysholm operating principles. As rotors unmesh in lower part of casing, spaces formed between lobes and casing open up into the inlet port, allowing air to enter and fill the volume. When front ends of spaces move past cutoff point on the inlet port, these air volumes are trapped. Fig. 10a shows in the two shaded portions the two volumes of air trapped by each rotor, with male lobe *a* just starting to mesh with female lobes *c* and *d*. Further rotation with the forward end of male lobe *a* fully meshed is shown in Fig. 10b. The merging and consequent reduction in

total volume of the two air masses caused by the lobe meshing is evident. In the position shown, shaded spaces are just about to open to the discharge port. Air will be completely discharged against the higher pressure from the rotor spaces by their continued meshing to the back end.

CENTRIFUGAL COMPRESSORS

Centrifugal compressors are widely used in aircraft gas turbines but have not yet been applied in other commercial types although Elliott's new locomotive unit (see p 96) will employ a 2-stage centrifugal. Fig. 7 shows a centrifugal compressor rotor from a General Electric jet engine; its principle of operation is familiar. Air trapped between rotor blades is thrown out past blade tips by centrifugal force. A stationary diffuser closely fitted about the rotor converts the velocity energy into pressure by deceleration. The vacuum that tends to form causes atmospheric air to enter the rotor to replace air thrown out by centrifugal action, thus maintaining air flow.

Fig. 11 shows the operating characteristics of these three basic compressor types. The axial is essentially a constant volume-flow machine and has a fairly narrow stable range. While a centrifugal can be operated stably over a wider volume range it also shows unstable characteristics at low flow rates. In the unstable region air flow becomes highly erratic, dropping to zero and then surging to a high value in short intervals.

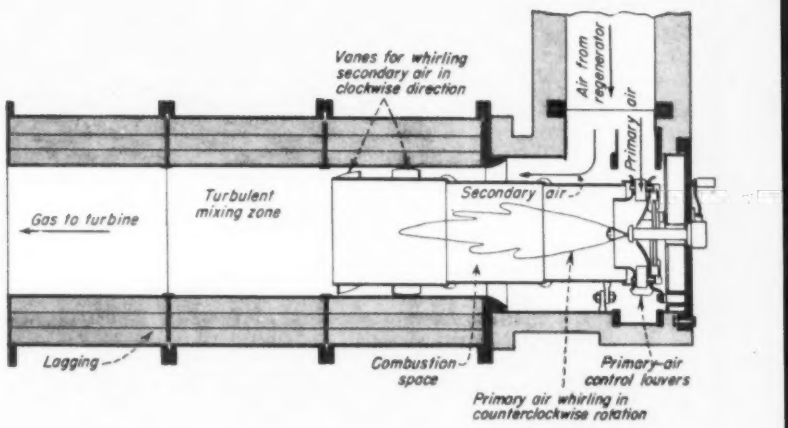
The Lysholm compressor, a positive-displacement machine, displays the most stable characteristics. In contrast to the others, in which pressure is a unique function of speed, and capacity range at any particular speed is restricted, the Lysholm can deliver volume in proportion to speed, and at any particular speed can work against any pressure up to the design limit.

Benefits of compressor intercooling are well known. Less is known of the advantages of water injection; research now in progress indicates possibilities for obtaining higher efficiencies by reducing outlet "flue" gas temperature by injecting water ahead of the regenerator.

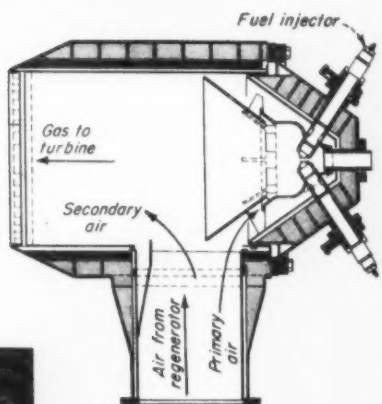
COMBUSTION CHAMBERS

Extremely high rates of heat release characterize gas-turbine combustion chambers which, for open-cycle plants burning liquid or gaseous fuels, are relatively simple in construction. The double-shell chamber of Fig. 12, is typical of units built by Brown Boveri and Allis-Chalmers. Since maximum usable temperature at the turbine inlet is in the range 1100 to 1500, compared to 3000 or 4000 F in the com-

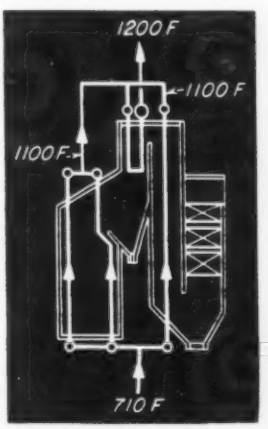
COMBUSTION CHAMBERS AND AIR HEATERS



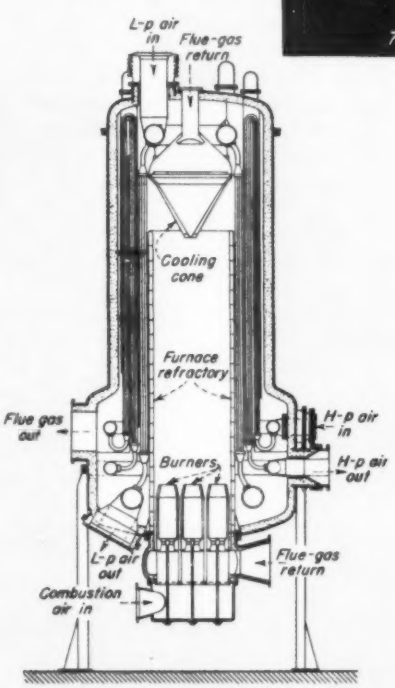
12 Double-shell chamber of Allis-Chalmers 1500-F unit: only combustion air enters flame area; flow of excess air cools metal sections



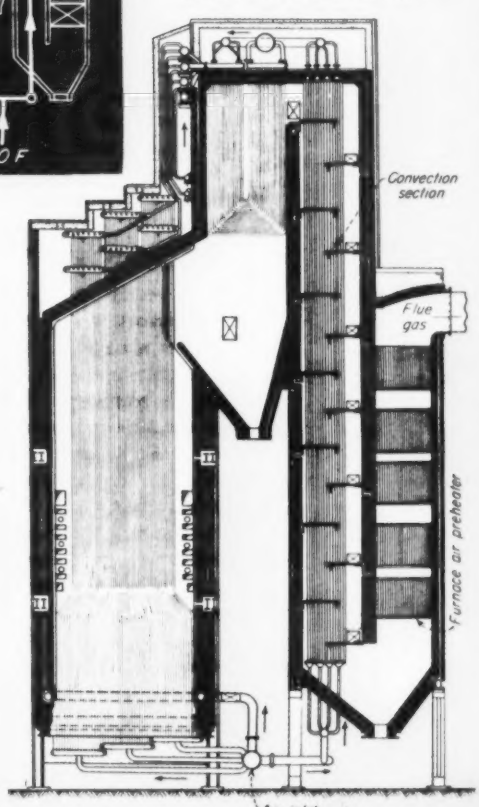
13 In Elliott combustion chamber fuel is injected intermittently by diesel-type equipment for a turndown range of 20 or 30 to 1. Sharp change in air-flow direction produces vortex action for mixing of combustion products and excess air

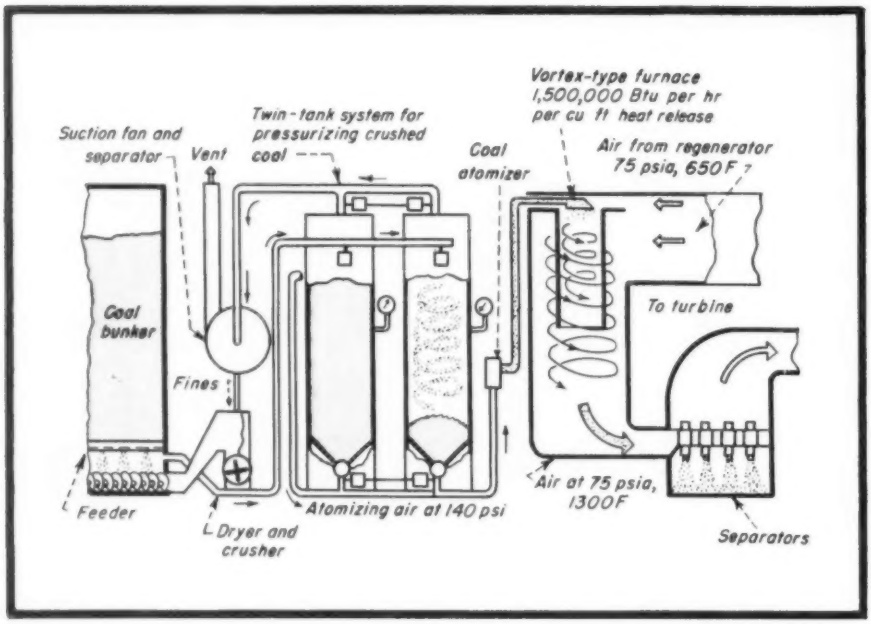


14 Oil-burning two-stage supercharged air heater for closed-cycle plant of 25,000 kw capacity



15 Pulverized-coal-fired design for closed-cycle has combustion-air preheater. Diagram at left shows air-flow circuits





LAYOUT OF COAL-BURNING SYSTEM FOR GAS TURBINE

16 Coal handling and combustion plant proposed for gas-turbine locomotive by Locomotive Development Committee. Coal taken from bunker by a screw feeder is crushed to 8-mesh, discharging to twin pressurizing tanks that are filled alternately. From here coal flows through jet atomizer where it is pulverized by air pressure drop. Coal then burns in cyclone furnace and combustion products mixed with excess air pass through battery of Aerotec tubes where about 95% of flyash is separated from gas. Tests indicate that fine particles passing into turbine do not cause blade erosion

bustion zone, large quantities of excess air are essential. The double-shell design takes advantage of this excess air to maintain metal parts below critical temperature levels and avoid need for refractory constructions.

Incoming air from the regenerator divides into two streams, combustion air entering the flame tube behind the burner nozzle through a register with movable vanes controlled from outside. In this way only sufficient air for combustion enters the flame area and ignition troubles from large quantities of cold air quenching the flame are avoided. The major portion of the air flows through the annular space between flame tube and combustion chamber wall, cooling the flame tube. Vanes in the annular space give the air a spin opposite in rotation to that of flame and combustion products, promoting turbulence and good mixing.

A mechanical-atomizing nozzle injects oil continuously; rate can be varied through a wide range in response to load demands. Heat releases of 2.5 million Btu per cu ft per hr have been attained.

VORTEX DESIGN

Fig. 13 shows the combustion chamber of the Elliott gas turbine. Here air from the regenerator enters at the bottom, part being diverted to enter the ignition cone through slots shown. The main body of air makes a right-angle turn, forming two vortices into which oil is injected. The comparatively small flame has an estimated temperature of 3000 F. Heat release is 2.5 million Btu per cu ft per hr.

Injection equipment similar to that employed in diesels, operating at a frequency of 160 pulses per second to produce a continuous flame, gives a turndown range of between 20 and 30 to 1 for part-load operation.

CLOSED-CYCLE AIR HEATERS

Air heaters for closed-cycle plants have been designed for firing oil, gas or coal, and for atmospheric or supercharged combustion. Most designs bear a superficial resemblance to modern boilers, but there are no drums and small-diameter thin-wall tubes are used. Working from gas to gas, heat-transfer conditions, even allowing for influence of high air density, are fundamentally poorer in air heaters than in boilers. However, ingenious heating-surface layout reduces tube-wall temperatures in some areas, substantially reducing the amount of surface that must be constructed of alloy steels. Air-heater flue gas is usually employed to preheat combustion air. While advantageous from over-all and combustion-efficiency standpoints, this involves higher furnace temperatures and hence more severe tube conditions. Accordingly, Escher Wyss recirculates some flue gas to control furnace temperature within safe limits.

Air-heater design depends on nature of fuel to be burned. Fig. 14 shows the layout of a supercharged oil-fired air heater, with reheat circuit included, for a 25,000-kw plant. Tube diameters range between ¾ and 1.5 in. The air heater of Fig. 15 burns pulverized coal at atmospheric pressure to supply a 12,000-kw plant. The small diagram indicates air-flow circuits through the heater and illustrates the way in which heating-surface layout employing counterflow and parallel-flow transfer is used to reduce amount of surface to be built of high-temperature metals. Returning part of flue gas to furnace holds temperature entering convection section at 1850 F. Flue gas preheats combustion air.

For plants of equal capacity, air-heater size is comparable to that of a modern high-pressure steam generator. Present estimates of construction cost in this country, influenced by the large amount of high-temperature alloy steel required even with ingenious design, run considerably above costs of comparable steam generators.

RESEARCH IN COAL BURNING

Fuel requirements of gas-turbine plants vary widely. In principle, closed-cycle plants can burn any fuel — at the other end of the range we have the high-specific output aircraft plants, limited to light distillate fuels. Most open-cycle plants for rail, marine or stationary service will handle Bunker C fuel oil, although some now prefer diesel oil. Gas, of course, proves highly suitable as a fuel.

Ability to burn coal in the open cycle seems essential to its assuming wide commercial importance. This presents a threefold problem: (1) handling and pulverizing coal for pressurized combustion (2) burning coal at rates many times higher than conventional practice, and (3) keeping flyash concentration in gas passing through the turbine to an acceptable minimum.

The Locomotive Development Committee of Bituminous Coal Research, Inc, formed by six major coal-carrying railroads and three large coal producers, is engaged in a comprehensive program to develop a coal-burning

gas-turbine locomotive. Intensive investigation of individual phases has been carried forward, the Committee is now sponsoring building and testing of a full-scale coal-handling and combustion layout at the Dunkirk plant of American Locomotive Co, and it has placed orders for two gas-turbine power plants (see pp 96).

Fig. 16 illustrates diagrammatically preparation and burning apparatus now visualized. Reciprocating plates in the bunker bottom deliver coal to a screw feeder from all parts of bunker at a uniform rate. Screw feeder discharges to a crusher which reduces coal to pass 8-mesh. A suction fan transports crushed coal to a twin-tank pressurizing system.

To maintain continuous coal flow, tank operation is alternated so that while one tank is being filled, the other is under air pressure, delivering coal to an air-jet pulverizer or "atomizer." In this device, coal and compressed air flow through a nozzle where sudden pressure drop, about 60 psi, causes air that has seeped into the coal pores to expand with explosive force, shattering it to a fineness approaching that of commercial pulverization. Air and coal, still at high velocity, then whirl around a small chamber where attrition further reduces coal particle size.

Combustion chamber will be characterized by highly turbulent mixing, with the large quantity of necessary excess air being used to maintain metal parts at reasonable temperatures and to avoid slagging at the high rates of heat release on which design is based.

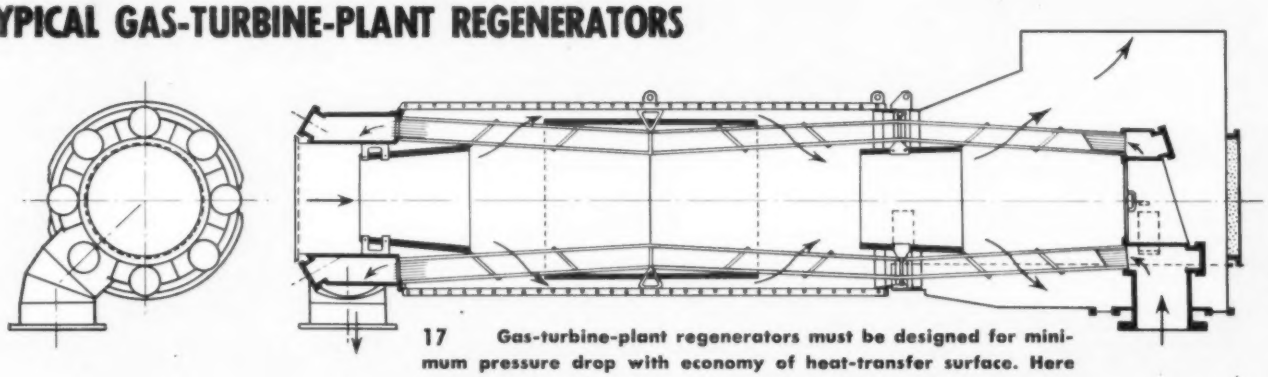
Hot gas from the combustion chamber enters a battery of Aerotec tubes, small high-efficiency cyclones. Preliminary tests indicate that this fly-ash-separation method will remove approximately 95% of solid particles with a pressure drop in the neighborhood of one psi. This represents virtually complete removal of particles above 5 microns in size. Research at Battelle, sponsored by Allis-Chalmers, indicates that particles of 5 microns and less tend to follow the gas stream and are unlikely to cause blade erosion.

In an independent program, Westinghouse is investigating coal-burning for gas turbines along different lines, based on the premise that superfine pulverization will produce superfine, and hence harmless, flyash.

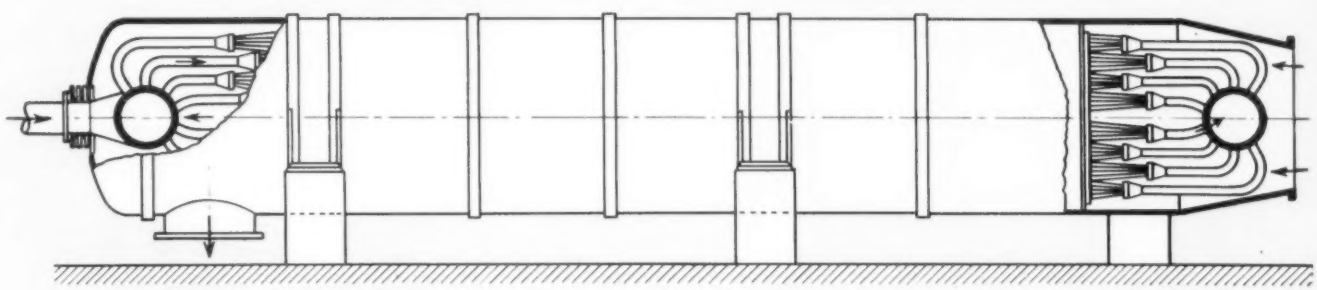
HEAT EXCHANGERS

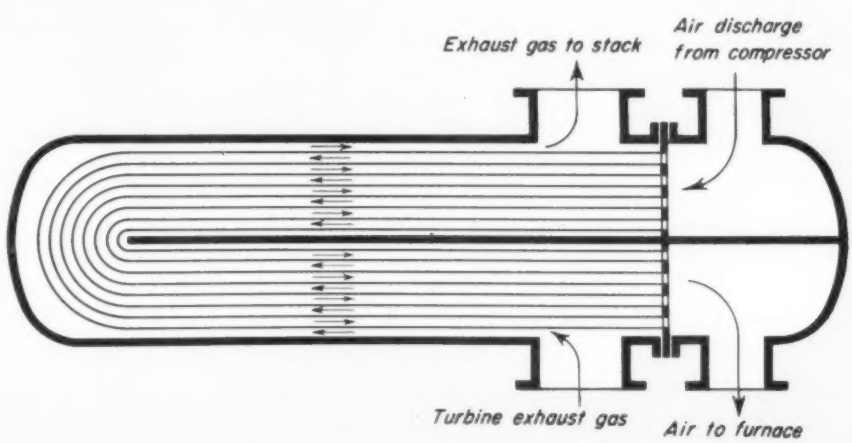
Gas-turbine-plant heat exchangers include intercoolers and regenerators and the air heaters and precoolers used

TYPICAL GAS-TURBINE-PLANT REGENERATORS



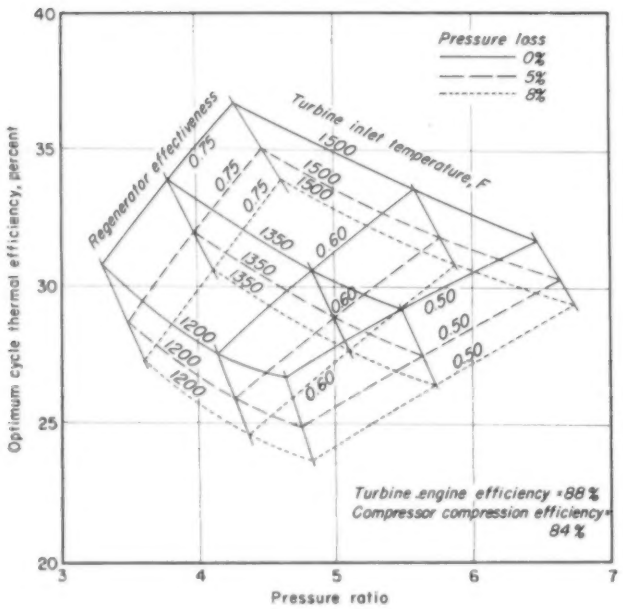
17 Gas-turbine-plant regenerators must be designed for minimum pressure drop with economy of heat-transfer surface. Here exhaust gas makes three passes over tube exteriors while the compressed air makes a single pass through the tube interiors

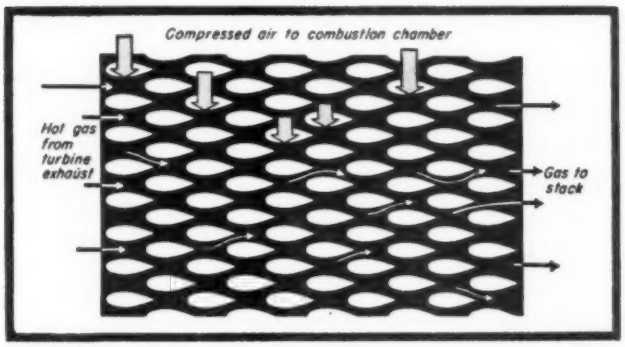




18 Regenerators for closed-cycle plants are characterized by very small tube diameters which may be employed because of the clean and dense air. Shells must be strong because of high cycle air pressure

19 Open-cycle regenerator designed for single-pass counterflow. U-tube layout shortens the over-all length for the given tube surface





20 **Above: Cross-section of regenerator tube layout shows use of streamlined tubing to minimize pressure drop of gas flowing across section and to increase gas surface density, thereby raising heat transfer and regenerator effectiveness**

21 ***Left:*** **Effect of pressure loss on optimum over-all thermal efficiency, in terms of pressure ratio, temperature and regenerator effectiveness, as figured for Locomotive Development Committee by Dr Eric Lype, Inst of Gas Technology**

in closed and semiclosed cycles. Air heaters have been described and intercoolers and precoolers do not depart markedly from usual practice.

The regenerator offers a challenge to designers: gas-to-gas heat transfer, with relatively small temperature drops and a strict limit on allowable pressure drop, tends to produce a bulky unit if any high degree of heat recovery is desired.

Typical regenerators are shown in Fig. 17, 18 and 19. In the open-cycle unit of Fig. 17, air makes a single pass through tubes arranged in eight groups. Turbine exhaust makes three passes across tube exteriors with turns planned for minimum pressure loss.

Fig. 18 illustrates a regenerator for a closed-cycle plant, in which only clean air reaches tube surfaces. This permits use of small-diameter tubes in bundles which connect to inlet and discharge manifolds. Both air streams make a single pass. Regenerator shell must be designed for higher pressures of the closed cycle.

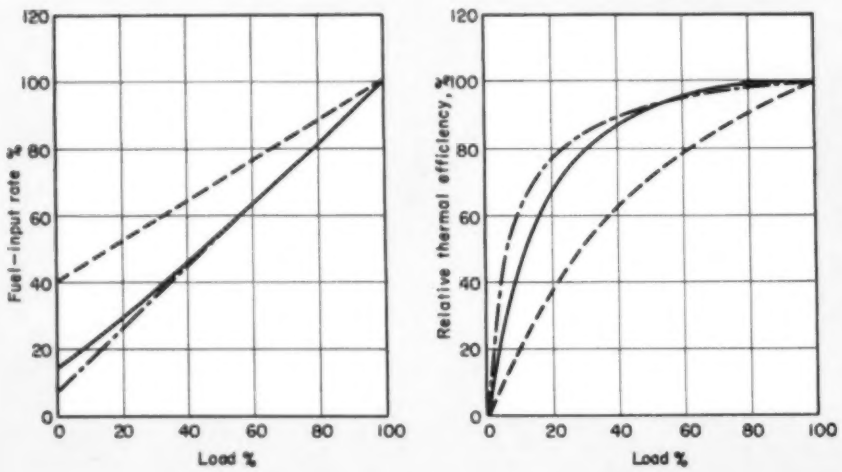
A regenerator design arranged to shorten over-all length by use of U-tubes is shown schematically in Fig. 19. Compressed air flows inside tubes and turbine exhaust outside; in effect, both make single passes.

All of these regenerators are arranged for counterflow; Fig. 20 shows a design for crossflow. Tubes carrying compressed air have tear-drop sections. Turbine exhaust flows across the tubes against their blunt-nosed sides. Gas flow remains streamlined but gentle changes in direction increase gas surface density adjacent to the tubes, improving heat-transfer rate.

The entire gas-turbine cycle is sensitive to pressure losses; thus all heat exchangers, piping and furnaces must be designed to keep pressure drop to an economical minimum. Fig. 21 demonstrates effect of pressure loss on optimum cycle thermal efficiency and pressure ratio. As pressure losses increase, thermal efficiency decreases and pressure ratio increases.

EFFECT OF CONTROL METHOD ON PERFORMANCE

22 **Unless throttle temperature is essentially constant, part-load efficiency suffers. This means control by varying air mass-flow rate is desirable where layout and equipment characteristics permit. In typical curves below, solid lines are for an open-cycle two-shaft machine with temperature held constant in upper half of load range and varied in lower half; dashed lines are for open-cycle single-shaft unit with speed constant and temperature varied; dot-dash lines for closed-cycle single-shaft constant-speed machine**



AUXILIARY EQUIPMENT

Because large air and gas volumes must be handled, gas-turbine-plant piping is large in comparison to other equipment. To conserve costly alloys high-pressure high-temperature piping is often made in double-wall construction. A thin inner tube of alloy steel serves to guide the hot gas. This tube is surrounded by insulation contained in a conventional steel pipe strong enough to withstand gas pressure. Insulation reduces temperature so that outer pipe performing the pressure-resisting duty is not overheated.

Piping joints and supports must be designed so that relatively large thermal expansions can occur without causing any misalignment of equipment.

Gas-turbines require some form of starting device, usually a motor. Capacity of such a unit need be only about 5% of plant capacity. Starting motor usually brings compressor and turbine up to about one-third normal speed, when furnace can be lit off. Turbine output is then sufficient to drive the compressor and unit is brought up to speed gradually by increasing the fuel input flow-rate accordingly.

POWER-GAS GENERATORS

If the continuous-combustion process of open- and closed-cycle gas-turbine plants is replaced by an intermittent process, such as occurs in the cylinders of a diesel engine, higher maximum temperatures can be tolerated without going beyond limits of existing materials. The power-gas generator, or free-piston compressor, does this, and the cycle in which it is used (see p 85) offers potentially high efficiency as a consequence.

The free-piston compressor consists of two piston assemblies diametrically opposed. Diesel pistons reciprocate in opposite directions, actuating air-compressor and "bouncing" pistons. Burning fuel in the central diesel cylinder forces the pistons apart, thus compressing air in the air cylinders and cushioning chambers. At stroke end, combustion gas exhausts through discharge ports at considerable pressure and temperature and forms the gas that drives the turbine producing the net output. Expansion of cushioning air and clearance air in compressor cylinder returns pistons to inner position.

Air cylinders take suction from atmosphere or from a supercharging compressor and discharge to diesel-cylinder inlet ports. All compressor-cylinder output goes to scavenge and supercharge the diesel cylinders. Piping between compressor and diesel cylinders acts as a receiver and smooths out pulsations. If a precompressor is used for supercharging the air cylinders it is an axial-flow unit able to handle the large-volume low-pressure compression efficiently.

Pressures of diesel-cylinder inlet air and discharge gas are practically equal. In Fig. 24, pistons are crank-interconnected, not to control relative travel but to actuate and time fuel injection.

LOAD CONTROL

Control of gas-turbine output is essentially simple; the means chosen depends on plant layout and nature of load. Single-shaft open-cycle plants operate essentially under direct fuel control. This means variable-temperature constant-flow operation, which has the merit of simplicity but gives poor part-load characteristics.

Where good part-load characteristics are essential, for either constant- or variable-speed operation, it is customary to use a two-shaft machine, with compressor and driving turbine on one and the output turbine on the other. This permits varying compressor speed to control flow rate and turbine inlet temperature can be held essentially constant. Amount of flow-rate variation possible depends on compressor characteristics; it is in this connection that the Lysholm compressor, with its wide stable range, has particular merit.

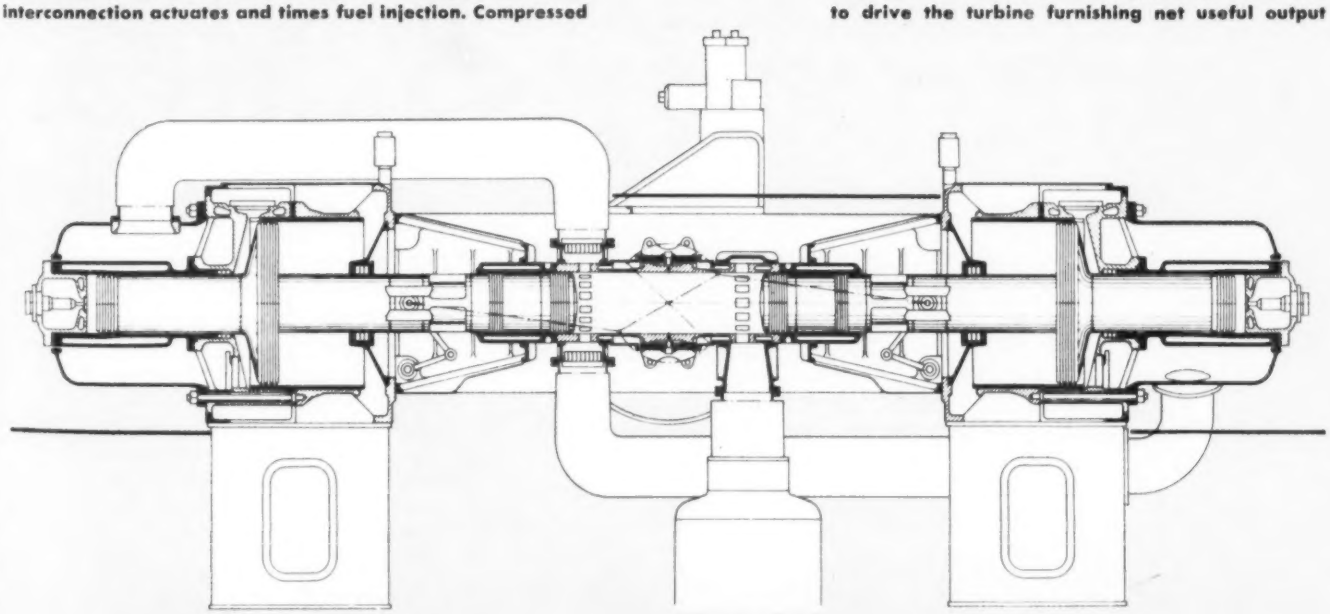
By using a turbine with Birmann blading with variable vane-position control on the inlet nozzles, gas-flow rate can be changed without altering turbine temperature or compressor speed.

In the closed cycle, constant-temperature operation can be attained by adjusting working-medium density to meet load changes. In essence, a small compressor maintains pressure in an accumulator from which air enters the system on load increase. On load decrease, air bleeds from the system into a low-pressure chamber from which charging compressor takes suction.

In the power-gas cycle, a typical arrangement would include several generators supplying power gas to a single compressor. Three possible control schemes could be used: (1) with generators supplying gas at constant pressure, throttle gas flow to a turbine with fixed nozzle area (2) with generators operating at constant pressure, use a multi-valve gas control on a turbine arranged for partial admission, and (3) operate generators to supply gas at variable pressure to a turbine with fixed nozzle area. Of these, the throttling arrangement seems least efficient, with the latter two being about equal at heavy loads and the variable-pressure arrangement better at light load.

CONSTRUCTION OF POWER-GAS GENERATOR OR FREE-PISTON COMPRESSOR

23 Power-gas generator, of Sulzer design, comprises diesel and air piston assemblies in opposed arrangement. Crank interconnection actuates and times fuel injection. Compressed air supercharges and scavenges the diesel cylinder; exhaust from diesel cylinder supplies pressure gas to drive the turbine furnishing net useful output



APPLICATIONS

Today there are many more gas turbines in aircraft than on land or sea. Jet propulsion, Fig. 1, is firmly established in the high-speed high-altitude range, so far entirely for military use. Commercial aircraft applications are under study here and in England.

Better suited to moderate speeds and normal altitudes, and superior with respect to length of takeoff required is the gas-turbine-driven propeller unit, Fig. 1, expected to have immediate commercial application but not yet in the air. The "propjet" offers some advantages over jet propulsion in range and cargo capacity.

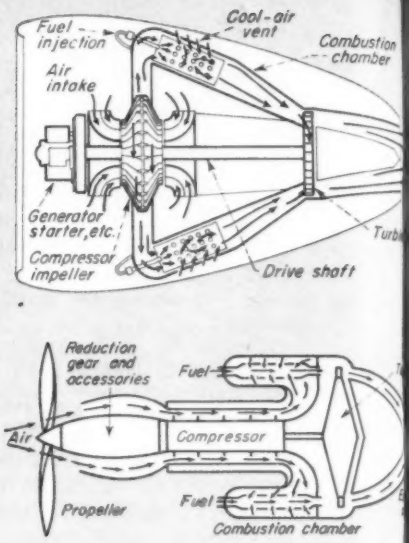
Expectations that the gas-turbine will eventually dominate aircraft propulsion rest on the belief that the industry will demand ever larger and faster planes, for both of which problems gas-turbines promise answers.

Most British jet engines and some American designs use centrifugal compressors, but the trend here seems toward axial units. Turbines are usually single-stage impulse wheels operating at temperatures of 1600-1800 F, possible because of short life requirements. Multiple combustion chambers for light distillate oils, such as kerosene, work at enormously high specific outputs, up to 8-10 million Btu per cu ft per hr, despite simple sheet-metal construction.

ROAD LOCOMOTIVES

The gas turbine appeals as a locomotive power plant because it is simple, compact and requires no cooling water, has inherently low maintenance and high availability characteristics, and can be built in large powers within a single cab. Efficiency is better than steam, which can burn coal, and lower than diesel, which burns oil.

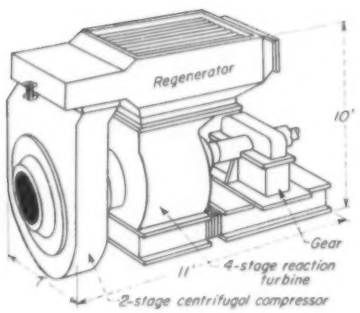
A substantial background of experience has been gained from operation of the first gas-turbine locomotive, a 2500-hp dc-electric-drive oil-fired unit built in 1940-41 by Brown Boveri for Swiss Federal Railways but now running in France on regular passenger schedules. By refinement of design of standard elements and addition of a novel "booster," 60% greater power is obtained from a new unit only about 3 ft longer than the first, exclusive of generators. This 4000-hp power plant, Fig. 4, is now under shop tests.



1 In top diagram, turbine absorbs only enough of gas-stream energy to drive compressor; remaining energy furnishes *jet propulsion*. In *propjet* hookup, below, turbine absorbs practically all energy in gas, to drive compressor and conventional propeller

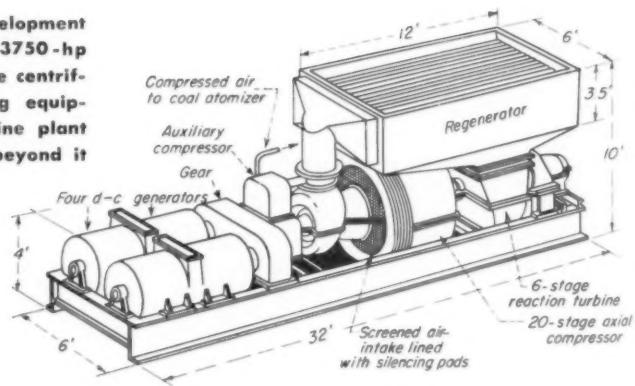
In this country, the Locomotive Development Committee (see p 92) has ordered two gas-turbine power units intended ultimately for coal-burning. One, to be built by Elliott, will have a 2-stage centrifugal com-

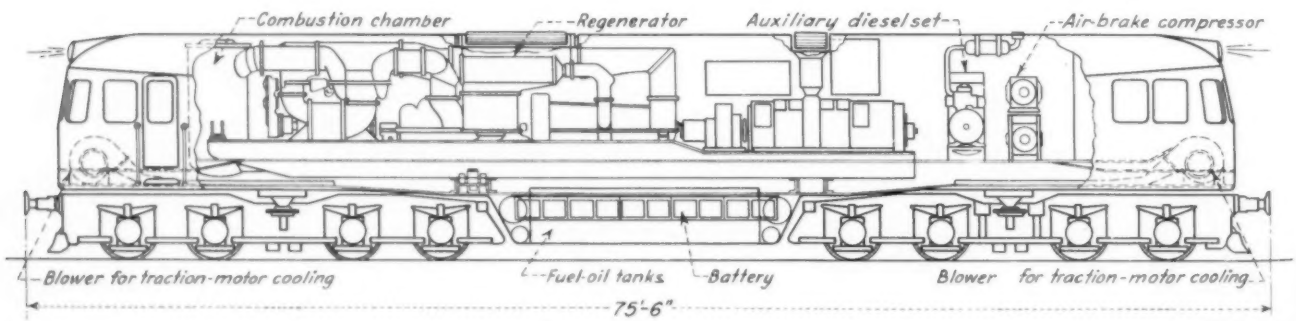
GAS-TURBINE POWER PLANTS FOR ROAD LOCOMOTIVES



2 *Left:* For Locomotive Development Committee Elliott will build 3750-hp power plant employing 2-stage centrifugal compressor. Coal-burning equipment is at right of gas-turbine plant with the generators located beyond it

3 Layout of gas-turbine plant to be built by Allis-Chalmers for LDC coal-burning loco. Rated at 3750 hp, unit has an axial compressor

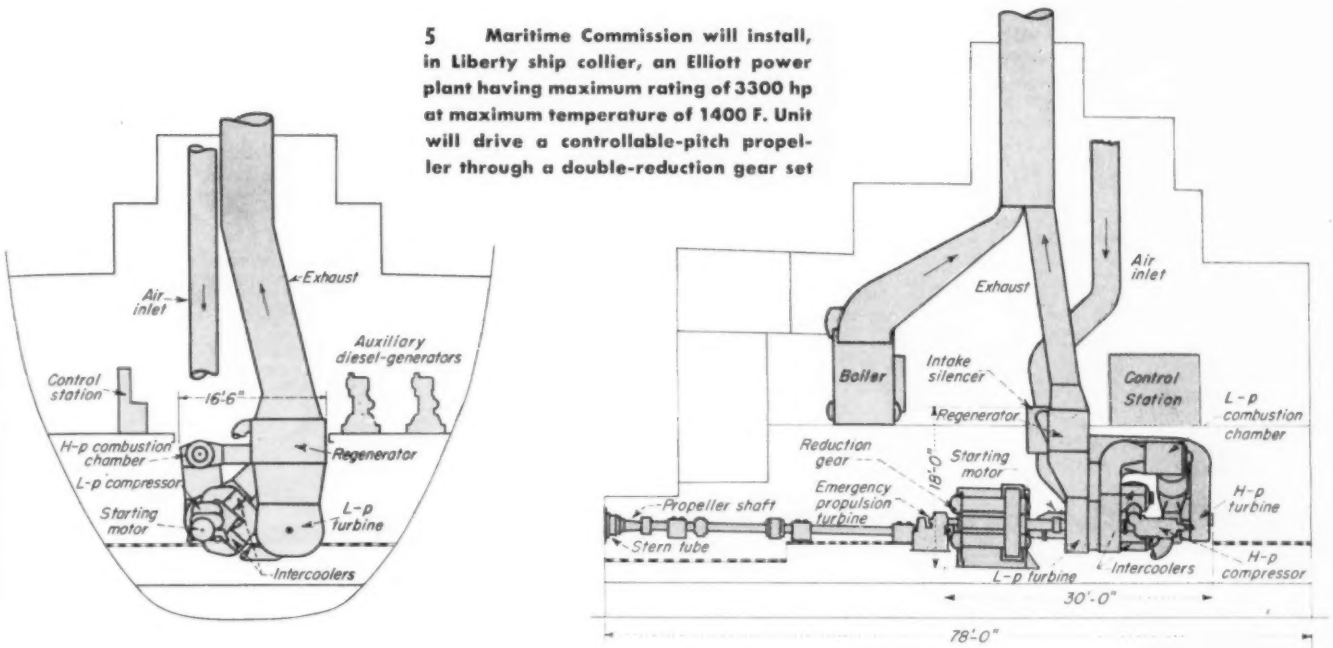




4 Brown Boveri's new 4000-hp power plant, embodying novel booster element, is only 3 ft longer than existing 2500-hp unit

LAYOUT FOR GAS-TURBINE PLANT TO BE INSTALLED IN A MERCHANT SHIP

5 Maritime Commission will install, in Liberty ship collier, an Elliott power plant having maximum rating of 3300 hp at maximum temperature of 1400 F. Unit will drive a controllable-pitch propeller through a double-reduction gear set



pressor, 4-stage reaction turbine and regenerator. Coal preparation and combustion equipment will be between power plant and generators, not shown. Rated 3750 hp and weighing 16.9 lb per shp, the unit has a shaft thermal efficiency of 22%. Turbine operates at 1275 **F**, 6340 rpm; compressor discharges at 58.4 psia pressure.

Allis-Chalmers propose, Fig. 3, a 20-stage axial compressor (70.7 psia), 6-stage reaction turbine and regenerator. With turbine operating at 1300 F and 5600 rpm, thermal efficiency is 23.5% and weight per shp is 21.8 lb.

A number of other gas-turbine locomotive projects are reported. General Electric is working independently on an oil-fired locomotive power plant of 4500-hp capacity, with an axial-flow compressor. Details of this design are not yet available. The 2000-hp Westinghouse unit, p 82, while not specifically designed for locomotive service, would prove readily adaptable, it being possible to place two such units side by side in a standard cab. At least one locomotive project is reported under way in England, for Great Western Railway, but no details are available.

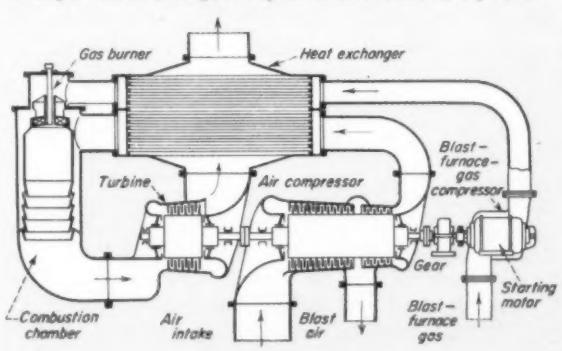
MARINE APPLICATIONS

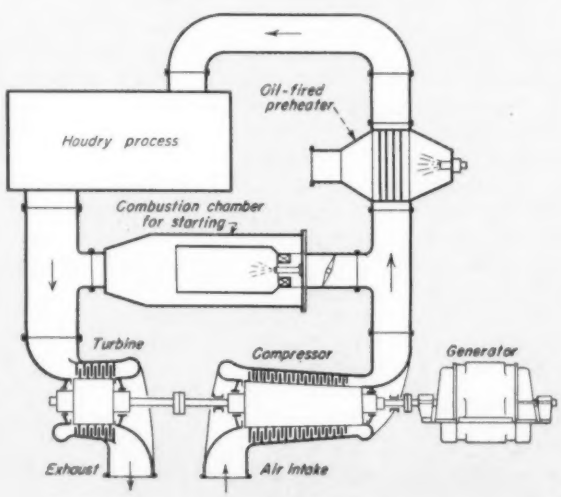
Ship-drive gas turbines are being proposed in Switzerland, England and this country. Brown Boveri designs call for open-cycle machines; Sulzer Bros are testing a semiclosed-cycle plant (see p 84); the British intend to replace one of two diesels in a new tanker with a projected gas turbine.

As a result of our own extensive Navy program, many marine units have been designed or built. The first commercial gas-turbine installation will undoubtedly be the Elliott unit now under construction for the Maritime Commission for conversion of a Liberty ship collier. Designed for maximum 3300 shaft hp at 1400 F and weighing about 20 lb per shp, power unit efficiency is estimated to be 29.7%, corresponding to 0.437 lb diesel oil per shp. Reduction gears and a controllable-pitch propeller will

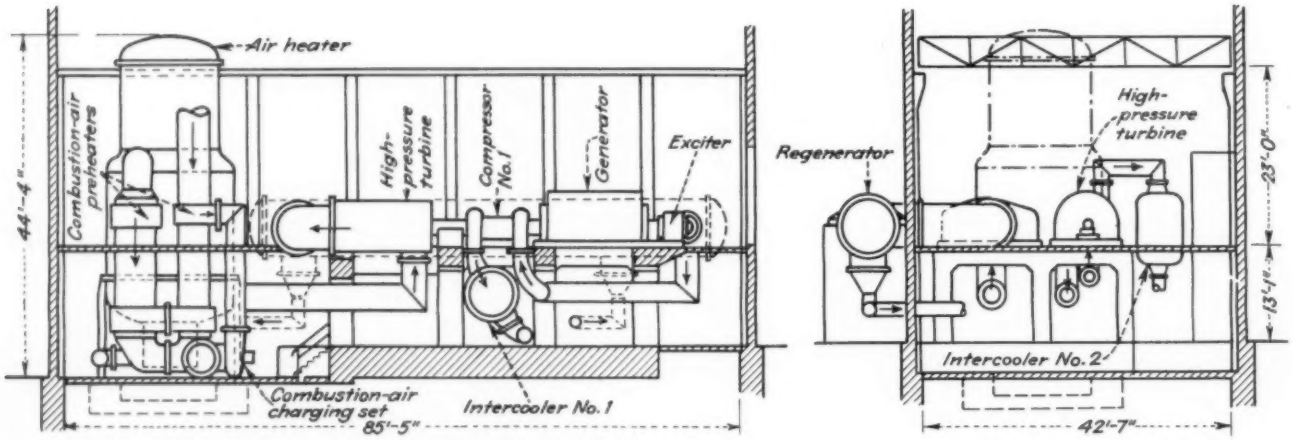
GAS TURBINES FIT INDUSTRIAL PROCESSES USING AIR UNDER PRESSURE

6 Diagram shows hookups for, *left*, blast-furnace-gas-fired turbine plant supplying blast air for furnaces and, *right*, the arrangement employed in the numerous catalytic-cracking units to supply compressed air to catalyst cases. Hot-gas surplus makes some net power

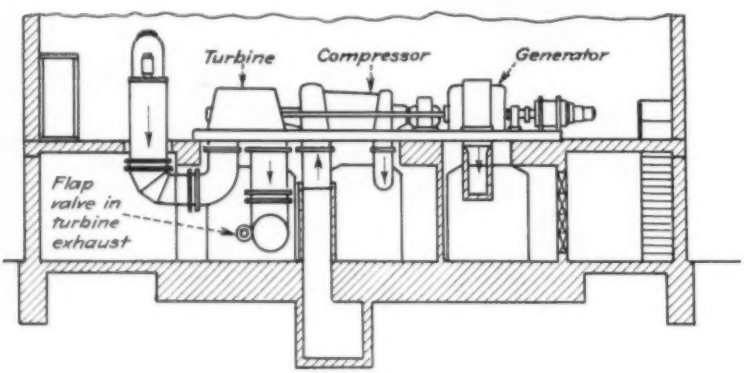


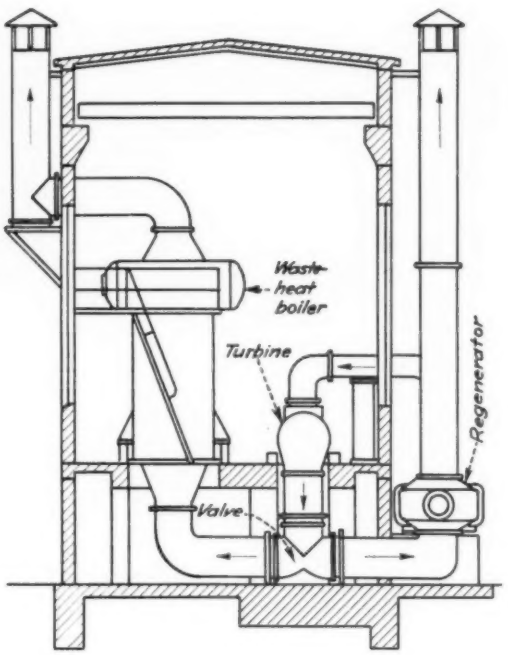


TYPICAL DESIGNS FOR CENTRAL-STATION AND INDUSTRIAL POWER PLANTS



7 Layout above is for 25,000-kw closed-cycle power plant generally similar to 12,500-kw one now being built by Escher Wyss and described in POWER, Aug 1946, p 90. Design below shows application for generation of industrial power and steam. Gas from exhaust of open-cycle turbine may flow into regenerator to increase efficiency of power generation, or may be diverted by a valve to a waste-heat boiler to produce process steam





be used for this marine installation.

Experience with more than 30 gas-turbine compressor sets built by Brown Boveri and Allis-Chalmers for catalytic-refining plants has thoroughly demonstrated the practicability of basic gas-turbine elements when operated for long periods at temperatures of 850 to 950 F. Outage records of typical units show off-the-line time averaging only about 2%.

Other process applications requiring large quantities of compressed air are in prospect, but the only machine known to be under construction is for a steel mill in Baracaldo, Spain. Built by Brown Boveri, this unit will deliver 120,000 lb per hr of 29-psig air to a Bessemer converter, using blast-furnace gas as fuel.

Application of gas turbines to generation of electric power depends for the immediate future on versatility in meeting specific requirements as to type of service, fuel, lack of water supply or other unusual circumstances. That numerous places exist where the particular abilities of gas turbines apply is demonstrated by the fact that 12 such units, aggregating 78,000 kw, have been built or are on order, for plants ranging from standby to base-load power service, and in size from 1200 to 27,000 kw.

For base-load power generation, high efficiency is economically justified unless fuel cost is low. Hence plants for this service will probably employ most of the efficiency-improving devices. The 25,000-kw design of Fig. 7 (top), generally similar to a 12,500-kw closed-cycle plant now under construction by Escher Wyss, employs a regenerator, three intercoolers, and a stage of reheating combined in the air heater. Guaranteed efficiency at generator coupling is 35%.

As yet no intensive studies of industrial-power hookups for producing process steam as well as power have been published, but many possibilities exist. The design at bottom of Fig. 7, by Brown Boveri, shows an open-cycle turbine exhausting to a regenerator, for high-efficiency power generation, or to a waste-heat boiler to meet process steam demands.

This brief survey of applications indicates that conditions favoring the use of gas turbines have been sufficiently numerous to put their manufacture on a commercial basis, with wider application waiting only on higher efficiency, lower first cost and realization of full fuel flexibility, that is, the burning of pulverized coal.

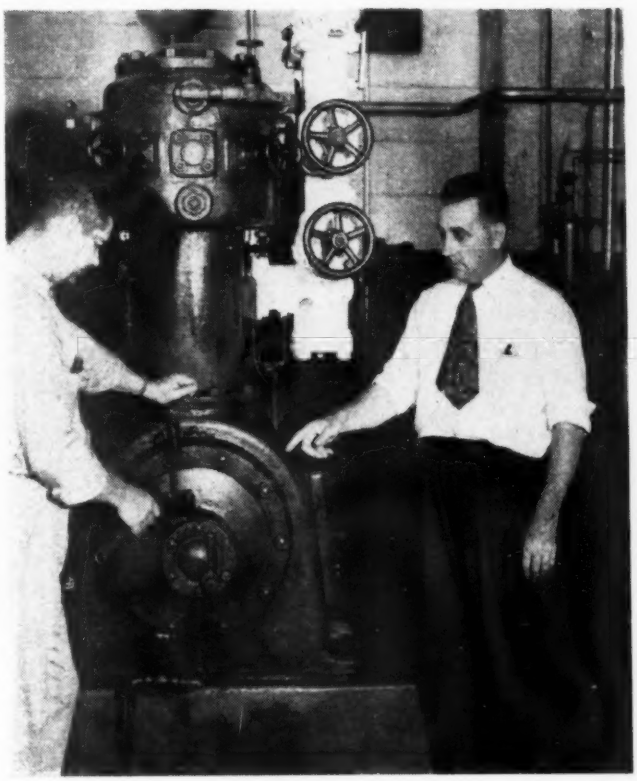
POWER PERSONALITIES

Men as well as machines make power. Here are on-the-job views of some of these men—their training and experience, their responsibilities, their philosophy of work — the things that make for success in the power field

George E Wills, master mechanic of the George Muehlebach Brewing Co, Kansas City, Mo., is the newly elected president of National Association of Power Engineers.

Back in 1937, George arrived in Kansas City, where he assisted in designing and erecting the plant he now supervises. Of that experience he has this to say: "Thanks to the help of many engineers and information supplied by the manufacturers of brewing equipment we succeeded in building a brewery that today is modern in every respect." The 300,000-bbl-per-year brewery occupies one and a half city blocks. As master mechanic, Wills supervises maintenance of buildings and brewing, bottling, power and refrigerating equipment, as well as operation of power-service facilities.

The plant has a connected power load of 780 hp; 200 tons of refrigeration with three units; 275 cfm in air-compressor capacity and two compressors that recover carbon dioxide from fermenting beer. Steam, originally generated in their own plant, now comes from the local utility at 187 psi and 530 F, after which it is reduced to 120 psi and 370 F for brewing and bottling. Electrical energy is also purchased. George operates and maintains his plant with a staff of 15. Outside contractors, equipped to handle extensive alterations, do the major repair jobs under his supervision.



George E Wills, (right), in his capacity as master mechanic, supervises the operation and maintenance of all the brewing, bottling, power and refrigerating machinery

EARLY ENGINE EXPERIENCE

Born in Ashland, Neb., George has fond memories of his childhood home, southeast of the town and overlooking the Platte River. Reminiscing, he recalls how he and his brother Charles designed and built a steam engine when he was twelve, and another when he was 15. Unique in design but quite successful, both engines used piston valves. The boys did most of the tool work, and the local blacksmith, Julius Olson, helped with the welding. The second engine developed five horsepower, and served many years as a play power plant.

George began his engineering career at 16. Fired with the desire for an engineering education, he worked out a program in his youth that he still follows: "I spend a fourth of of my time working, a fourth sleeping, a fourth studying, and [Lucky man!] I have never been asked to account for the remaining fourth." Somehow he saved enough to buy books on hydraulics, steam, electricity and refrigeration. He studied in his spare time while acquiring experience on diesel and steam engines and refrigerating machinery in various plants, as well as helping build and operate a small water-power plant. He also studied business, commercial and mechanical subjects, and power-plant chemistry.

At 24, Wills moved to Omaha, where he passed a rather stiff examination and was awarded a second-class license—next to highest out of five possible grades. From 1924 to 1929 he supervised the operation of steam-driven generators (both ac and dc) and factory machinery. At night school he studied mathematics, mechanical engineering, drafting, electricity, refrigeration, and the infant subject of air conditioning, as well as English and public speaking.

After acquiring a first-class engineer's license in Omaha, Wills installed equipment and served as superintendent for the Lewis Shepard Co, builders of hoisting and materials-handling equipment, in Crawfordsville, Ind. He was forced to leave when the depression caused a drastic curtailment in the company's activities. Going back to Omaha he opened his own night school. Despite hard times the students paid cheerfully, and he managed somehow to make a living for his wife and himself.

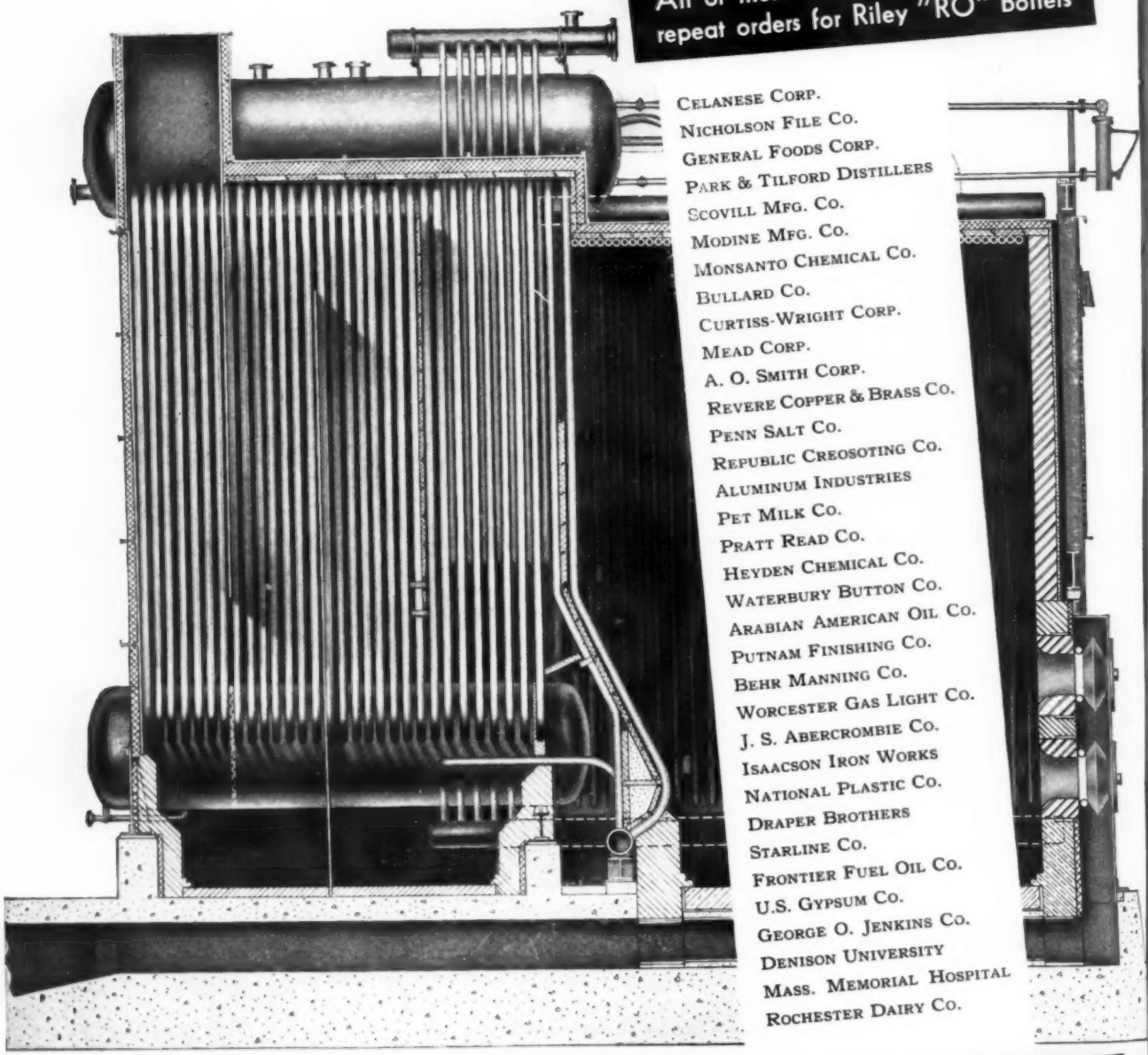
George continued teaching for some time while also holding down a job in the engine room and refrigeration department of Cudahy Packing Co. T J Byrnes, who was then general master mechanic of all Cudahy plants, gave Wills every opportunity to further his knowledge of packing-house refrigeration. He never misses an opportunity to counsel with this old friend, who is now with Vilter Co, Omaha.

As chief engineer in charge of buildings and machinery for the Metz Brewing Co he worked in Omaha from 1934 to 1937 when the company transferred him to Kansas City, Mo., to help design and erect the plant he now operates.

On his way to the presidency, George has been active in many NAPE capacities for the past twelve years. His progressive company encourages his participation in engineering-society activities and sees that he has reasonable freedom to carry on Association duties assigned to him.

Industry has adopted the Riley

All of these companies have placed repeat orders for Riley "RO" Boilers



- Celanese Corp.
- Nicholson File Co.
- General Foods Corp.
- Park & Tilford Distillers
- Scovill Mfg. Co.
- Modine Mfg. Co.
- Monsanto Chemical Co.
- Bullard Co.
- Curtiss-Wright Corp.
- Mead Corp.
- A. O. Smith Corp.
- Revere Copper & Brass Co.
- Penn Salt Co.
- Republic Creosoting Co.
- Aluminum Industries
- Pet Milk Co.
- Pratt Read Co.
- Heyden Chemical Co.
- Waterbury Button Co.
- Arabian American Oil Co.
- Putnam Finishing Co.
- Behr Manning Co.
- Worcester Gas Light Co.
- J. S. Abercrombie Co.
- Isaacson Iron Works
- National Plastic Co.
- Draper Brothers
- Starline Co.
- Frontier Fuel Oil Co.
- U.S. Gypsum Co.
- George O. Jenkins Co.
- Denison University
- Mass. Memorial Hospital
- Rochester Dairy Co.

RILEY "RO" BOILERS

for steam outputs up to 100,000 lbs./hr.
All types of firing

It doesn't take long for quality products to establish themselves

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It will pay you to visit modern Riley Installatio

"RO" Boiler because it pays to do so

Here are a few of the reasons why it pays to install Riley "RO" Boilers

Save Fuel

Riley "RO" Boilers operate at high efficiency and low steam costs. Rapid circulation, long gas travel, air-tight insulated setting, water-cooled furnace and the special integral economizer, all contribute to the unusually high efficiencies obtained with Riley "RO" boilers. The average "RO" boiler operates at an efficiency of over 80%.

Minimum of Maintenance

With rapid and positive circulation, heat is quickly carried away from the boiler and water wall tube surfaces minimizing the possibility of scale formation and tube failure. With the furnace refractories protected by water walls, furnace maintenance is also negligible.

Trouble-Free Operation

The Riley "RO" boiler is a high quality product including many of the features of the larger modern steam generating unit. Nowhere has its design or construction been cheapened to make it sell for a price. Its many outstanding features assure long trouble-free operation.

Produce Clean Dry Steam

With Riley "RO" boilers, most of the steam generated enters the upper drum above the water level where water and steam readily separate. This feature, together with the efficient steam separator, assures clean dry steam.

Rapid Steamers

Every user of Riley "RO" boilers is impressed by the rapid steaming characteristic of this unit. This feature assures rapid pickup and ease of carrying widely fluctuating loads with steady steam pressure.

Steady Water Level

Because of rapid positive circulation and the fact that most of the steam generated enters above the water level, a steady unagitated water level is maintained.

Easy to Operate and Maintain

The water wall headers of Riley "RO" boilers are equipped with removable hand hole covers making it possible to turbine water wall tubes with ease from outside the unit. The water-cooled furnace permits operation without objectionable slag and clinker formation. Throughout, the Riley "RO" boiler has been designed to give long, trouble-free, continuous operation.

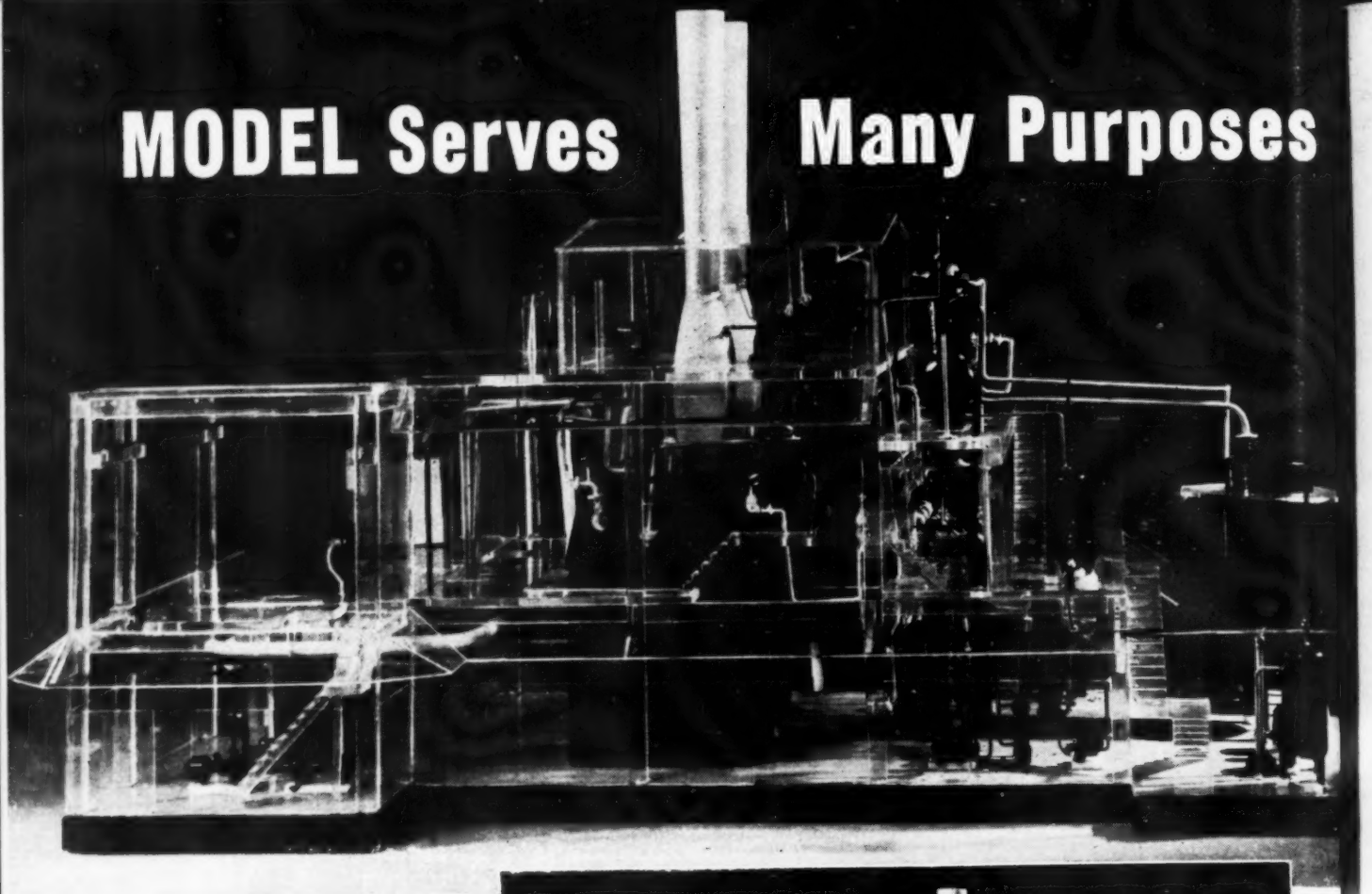
A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

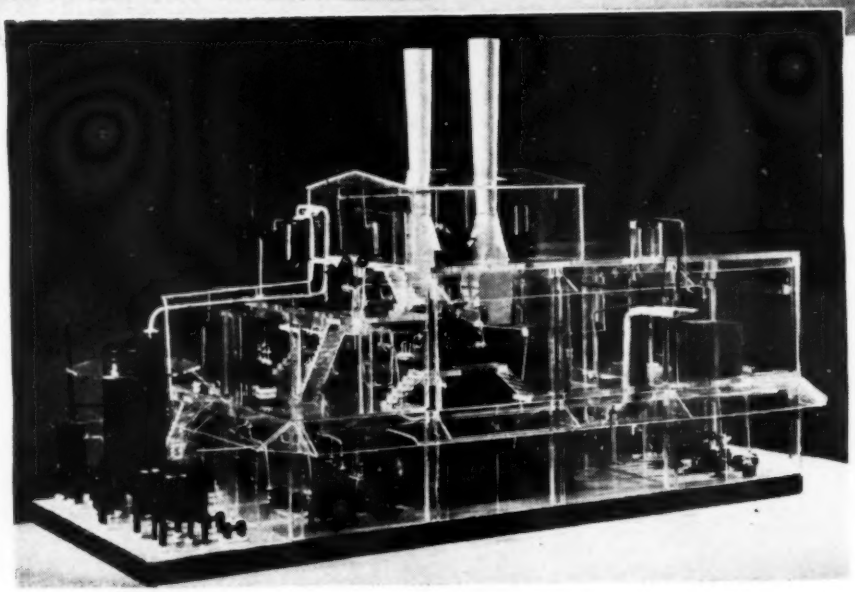
COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

efore purchasing Boiler or Fuel Burning Equipment

MODEL Serves Many Purposes





Above: Model of semioutdoor power plant designed for industrial use in a tropical climate. Superstructure made of Lucite permits direct examination of power equipment and piping in the model interior. Left to right are turbine room and condenser cellar, boiler room, feed-heating equipment and, finally, feedwater treatment apparatus. Right: View of model from opposite side showing feedwater heating and treatment plant outdoors

▶ BECAUSE OF THE MANY ADVANTAGES it affords, Alvin H Johnson & Co, consulting engineers, of New York, N. Y., built this model of an industrial power plant, designed for one of their clients. It clearly shows coordination of all plant equipment, enabling quick checks on design layouts. Study of the model helps in developing an arrangement with maximum operating accessibility, avoiding the use of elaborate control systems.

Another marked advantage lies in simplifying the contractors' work in preparing accurate bids on the construction job. This model will be taken to the erection site where it will aid the foreman in assembling the plant piping. This is important where the plant site is not readily accessible from the engineer's office. Finally, the model will be used to instruct the new operating crew even before the plant itself is completed.

Model is built to a scale of ¼ in. = 1 ft, and the superstructure is made of clear Lucite. Piping systems are painted in different colors for steam, water, oil, etc. W P Kearney, power engineer, designed the plant; the model was built by Frank Brinkman, who also assisted in the plant piping layout.

The plant will be located in Guatemala, Central America. Principal equipment comprises two 425-psig 510-F marine-type boilers, supplying in addition to the manufacturing plant a 1000-kw condensing turbine extracting at 60 psig and exhausting to a surface condenser. The turbine drives a 3-phase 60-cycle 440-v generator.

Building will be constructed mainly of reinforced concrete with corrugated aluminum canopies at the locations shown on the model. Below the canopies the walls will be open to provide ventilation while the turbine room will be totally inclosed to keep out dust.

A FREE ECONOMY IS WORTH FIGHTING FOR

BUSINESS must take the initiative if the price decontrol machinery, set up by Congress, is to be effective. The present price control law is far more than a set of instructions to the administrators of OPA; it is a challenge to business to be aggressive in speeding decontrol decisions and in persuading the Price Decontrol Board to adopt a strong stand for return to a free economy.

Thus far business has not met this challenge. *Two months after the passage of the new price law not a single application for decontrol of a major product had been filed by an industry advisory committee.* This is due in part to the red tape controlling such applications. Nonetheless, a continuation of such inactivity on the part of business can well result in perpetuating price control far beyond the time either the present law or sensible economic policy require.

It was the clear intent of Congress to hasten our return to a free economy. In the legislation continuing the general control of prices, Congress formally declared its purpose to have it "terminated as rapidly as possible."

To accomplish this, the House originally approved a formula which would have made decontrol mandatory when production had attained a prescribed level. The automatic decontrol provision was dropped before the bill was finally passed, partly because of the uncertain effects of strikes on production. But Congress did not mean to return the timing and extent of decontrol to the administrative discretion of OPA.

On the contrary, to assure having price control "terminated as rapidly as possible," Congress created a Price Decontrol Board and gave it power to overrule OPA when the board finds price control should be removed. Moreover, it gave to industry the right and the responsibility to seek decontrol. Also, in a further effort to speed up the decontrol process, it placed narrow limits on the time allowed for board decisions.

Congress had compelling economic reasons for doing its legislative best to speed up decontrol.

1. It is by all odds the best way to eliminate the bottlenecks in production and the black markets which have plagued the country since V-J Day.

> Rigid price ceilings promote shortages of badly needed commodities by discouraging their production. Such shortages both upset the flow of production and promote black markets. At present a considerable part of American industry is stymied by shortage of critical parts and materials. Price control is much to blame.

2. There must be flexibility of prices if a round of new wage adjustments, which may be forced on industry early in 1947, is to be negotiated without grave risks of seriously curtailing production.

> When, under the leadership of the national administration, the first post V-J Day round of wage adjustments was made, price ceilings were held rigid while wages were boosted. The result was a series of price-wage squeezes which upset production. They would have been disastrous if we had not been in a sellers' market, created by a tremendous accumulation of wartime shortages. In 1947, however, many industries will be in a buyers' market. It must be possible, therefore, to have wage increases reflected promptly in price adjustments if we are to avoid a repetition of the costly post V-J Day round of strikes, which often had price control as the key issue.

3. Rapid decontrol is necessary to maintain a high level of employment and production.

> Almost five years of price control inevitably twisted the factors of production and distribution far out of the equilibrium which would prevail in a free economy to which it is the clear purpose of the nation to return. Unless the return to a free economy is facilitated by a speedy and orderly decontrol, the jolt of an abrupt return to competition can be expected to upset employment and production seriously.

It's Up To Business

To encourage speed and boldness in decontrol, Congress provided for the reimposition of control over any prices which, after being released, might

get out of hand. The dangers of this sort are chronically exaggerated. During the 25-day period in July when there was no price control the Civilian Production Administration found that "manufacturers of finished industrial and consumer products have generally exhibited commendable restraint in increasing prices no more than increased costs."

All of this endeavor to speed up decontrol and expand its scope is likely to be futile, however, unless business furnishes the driving power for the machinery Congress provided. OPA certainly will not do it. Neither can the Decontrol Board be expected to go out and drum up cases.

The necessity for vigorous action by business in pressing for decontrol is increased by the fact that the general legislative standards to guide decisions by the Decontrol Board are vague. They must be clarified and sharpened by decisions in specific cases.

The main principle to guide the decontrol of non-agricultural products is that price ceilings shall be removed when supply is in approximate balance with demand. But what precisely does that mean? The meaning will become clear only through Decontrol Board decisions.

The same is true of the principle which makes automatic decontrol of a non-agricultural commodity contingent on whether or not it "is important to business costs or living costs." Business must press cases which will give specific meaning to those vague terms if decontrol is to get on apace.

Cards Are Stacked

At present the government has the cards pretty well stacked against rapid decontrol.

First, the key members of the staff of the Price Decontrol Board are holdovers from the Bowles regime which emphasized the importance of carrying on price control rather than speed in getting rid of it.

Second, in exercising his authority to prescribe regulations to govern petitions for decontrol, the OPA administrator has required excessively complicated statistical and economic data. Manufacturers who are sure they can convince any fair-minded board of the desirability of decontrolling certain of their products assert that they are blocked by statistical entanglements.

Third, OPA has discouraged business from moving immediately under one section of the law to speed decontrol. This section provides that products "not important in relation to business or living costs" may be freed from price ceilings immediately and must be freed by December 31, 1946, unles OPA specifically finds they are important to these costs. Instead of making it possible for business to move under this section now, OPA has issued rules which have the effect of blocking such a course until the end of the year.

In the light of obstacles such as these, it is not surprising that the record of decontrol to date is not impressive.

Decontrol Record

Since June 30 there has been a drop from about 70% to about 60% in the total value of products under price control. But most of the drop has been accounted for by food products, which Congress took the lead in decontrolling, and by industrial machinery which was being decontrolled when Congress acted. By far the larger part of manufactured consumer goods remains under control.

This, however, is no time for business to be discouraged. Rather, business should accept the obstacles put in its way as a challenge and work harder than ever for speedy decontrol.

The case for decontrol should not be stated in narrow technical terms. It should be based on grounds of broad public policy, and should demonstrate how a speedy return to a free economy can hasten the full release of the nation's productive power.

For example, there should be very clear demonstrations of how, in far too many cases, rigid price ceilings—(1) discourage production of key parts and materials by making such production relatively unprofitable, (2) create shortages of key parts and materials which tie up broad ranges of production or result in piling up lopsided inventories of partially completed goods, and (3) thus cut away the foundations of a stable economy and the prospects of steadily sustained employment.

There should be equally full demonstrations of the well known sequence from shortages to unrealistic price ceilings to black markets. Meat prices are rolled back, but the meat is rolled under the counter.

A free economy is worth fighting for. Liberty is preserved only by the constant struggle of those who believe in it. Neither the interests of the nation in a strong and well-balanced economy nor the interests of business itself will be served by drifting at this time. Now is the time for business to lead a strong offensive for speedy elimination of price control.

President McGraw-Hill Publishing Company, Inc.

THIS IS THE 51st OF A SERIES

Homemade Calculator Gives Power Factor

Rotating disk finds power factor in only one operation from kilowatt and kilovar instrument readings. J H Kerr, Jr, Gulf State Utilities Co, Baton Rouge, La., describes construction details and tells how one power plant uses calculator

Fig. 1—Circular calculator finds power factor in one operation from kilowatt and reactive kilovolt-amperes

▶IN RECENT YEARS more and more power-plant switchboards are being equipped with indicating reactive volt-ampere meters instead of power-factor meters. Reactive volt-ampere meters have definite advantages but eliminating the power-factor meter requires either a special chart or calculations and tables to determine power factor from wattmeter and volt-ampere-meter readings.

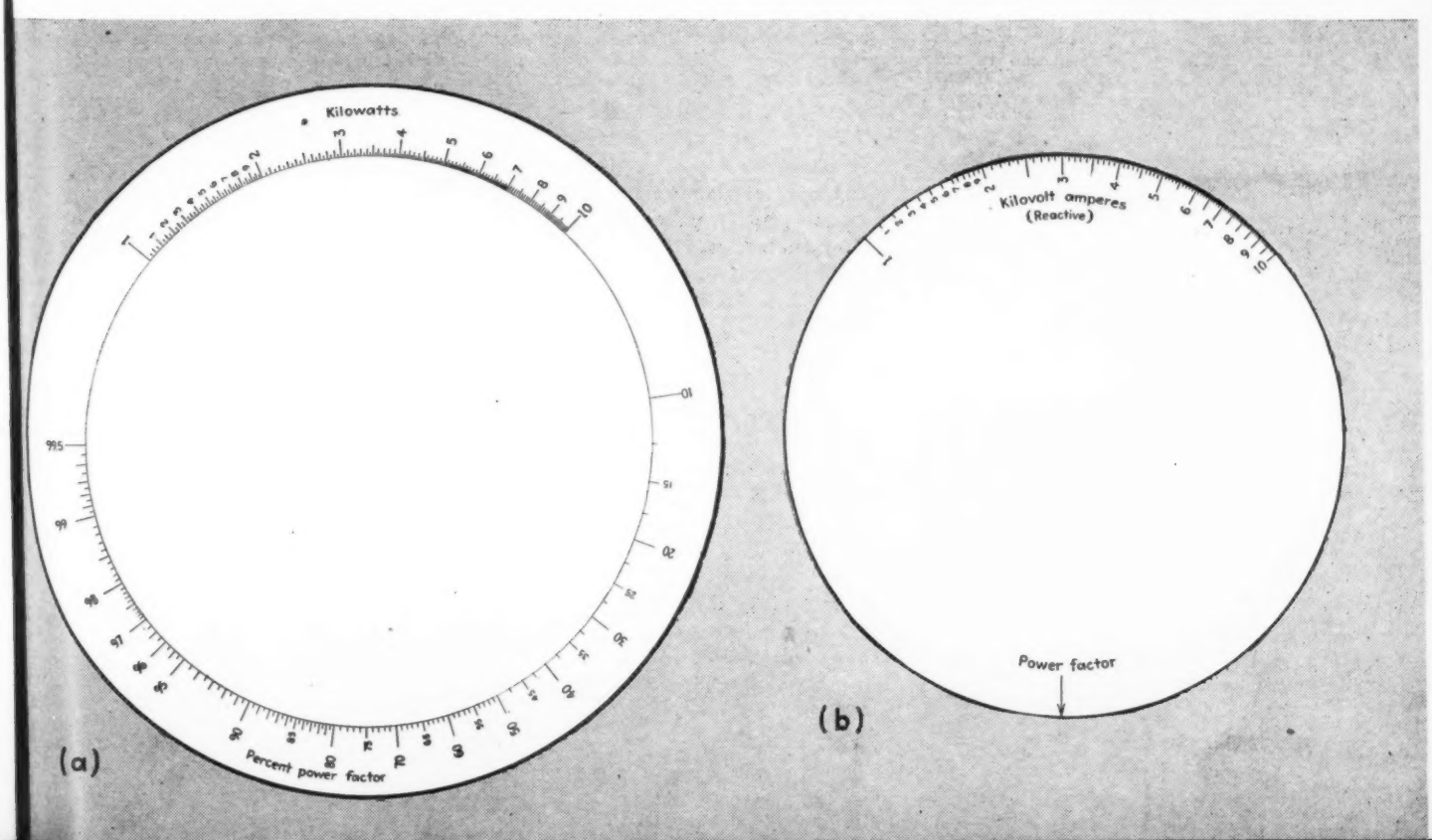
In one of our plants the switchboard operator is required to enter hourly power-factor readings on the log sheet for each generator and feeder circuit. He has to determine the power factor from the kilowatt- and kilovar-indicating instruments on the switchboard.

POWER-FACTOR VALUES

At first the power factor was obtained with a slide rule and a table of natural trigonometric functions. Later we prepared a chart, Fig. 3, from which we read power factor by finding intersection point of lines representing kilowatt and kilovar values, and reading power factor from the lines fanning out from the origin. Even with this chart power-factor readings were still tedious to obtain; therefore we set to work to develop an easier and more rapid method. We built a simple calculator, Fig. 1, that computes power factor direct from kilowatt and kilovar readings.

Calculator is a heavy circular piece of 15-in.-dia masonite board and a 12-in.-round fiberboard disk. A pivot was provided in center of fiberboard for

Fig. 2—Disassembled parts of calculator showing stationary disk (a), and rotating disk, (b). The kilowatt and reactive kilovolt-ampere scales are transferred from a slide rule, and power-factor scale is calculated from these two



mounting the disk so it would rotate. A logarithmic scale was accurately transferred to the face of the two disks, (a) and (b), Fig. 2. This can be done by gluing a piece of semi-log paper along the edge of the masonite board and drawing radii across the point where disk and board overlap. C scale of a 10-in. slide rule, which is logarithmic, can also be used in the same way by transferring the divisions to a strip of paper. These two scales represent slide-rule C and D scales, and can be used for the same purpose, namely multiplication and division.

TRIGONOMETRIC RELATION

The trigonometric relations of watts, reactive-volt-amperes and power factor can be obtained from the vector diagram, Fig. 4, in which:

$$\text{power factor} = \frac{\text{true power}}{\text{apparent power}} = \frac{\text{kilowatts}}{\text{kilovolt-amperes}} = \cos \theta$$

$$\tan \theta = \frac{\text{reactive kilovolt-amperes}}{\text{kilowatts}}$$

Power-factor values can be determined from the trigonometric relation $\text{Cos } \theta = \frac{1}{\sqrt{1 + \tan^2 \theta}}$ where tan θ is the value found from formula above. For convenience and as a timesaver, however, the values were read directly from the tables as described below.

To determine power factor from these relations divide reactive kilovolt-amperes by kilowatts; locate results of this division in tangent column of natural trigonometric table and take cosine corresponding to the angle. This is power-factor desired and is value used in laying out the calculator.

On the calculator we labeled upper- or stationary-scale kilowatts and rotating-scale reactive kilovolt-amperes. Power-factor indicator on the disk we placed at a convenient location. Power-factor scale was determined from above listed relations by choosing uniform values of power factor (cosine of angles) and working back from cosine to tangent column corresponding to the angle in trigonometric table. This tangent value from the table was set off on bottom or kilovolt-ampere scale by placing the number under the unit or 1 of kilowatt scale for power-factor values below .707, which is 70.7%, and corresponds to 45 deg and under the 10 of the kilowatt scale for values of power factor above 70.7%. Location of power factor (cosine) originally chosen was marked on percent power-factor scale in the position indicated by power-factor indicator or arrow at bottom of disk. Scale shown is from 10 to 99.5% although most power-factor values are above 70%.

In operation the calculator is manipulated somewhat as a slide rule. That is, kilowatt reading is on upper scale and reactive kilovolt-ampere reading on lower scale. Disk is rotated until these two values are brought together. Corresponding power factor is read directly under arrow on bottom scale. For example: kilowatt meter indicates 60,000 kw and reactive kilovolt-ampere meter indicates 20,000 kilovars; by placing the 2 of kilovar scale under the 6 of kilowatt scale the power-factor indicator points to 95%, Fig. 1, which is power factor of system indicated by the two instruments, and read directly from the calculator.

Parts of calculator in Fig. 2 can be enlarged for convenience, or easily assembled as shown, and made to serve a useful purpose in many power plants.

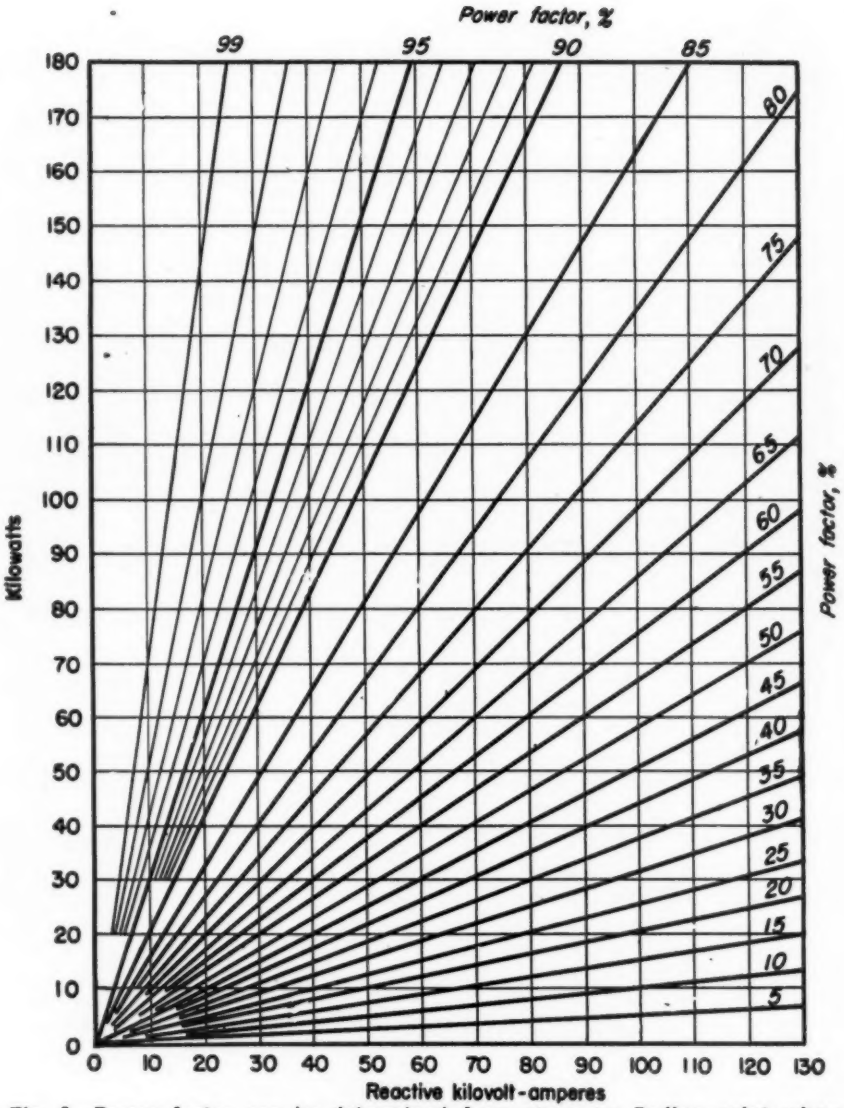


Fig. 3—Power factor can be determined from chart by finding point where kilowatt and reactive kilovolt-ampere values intersect and reading power factor from radial lines. This method is some improvement over the slide-rule and trigonometric table method of finding power factor, but was considered too slow

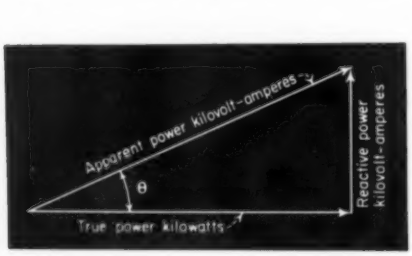


Fig. 4—Vector diagram shows relation of apparent true and reactive power used for the calculating board

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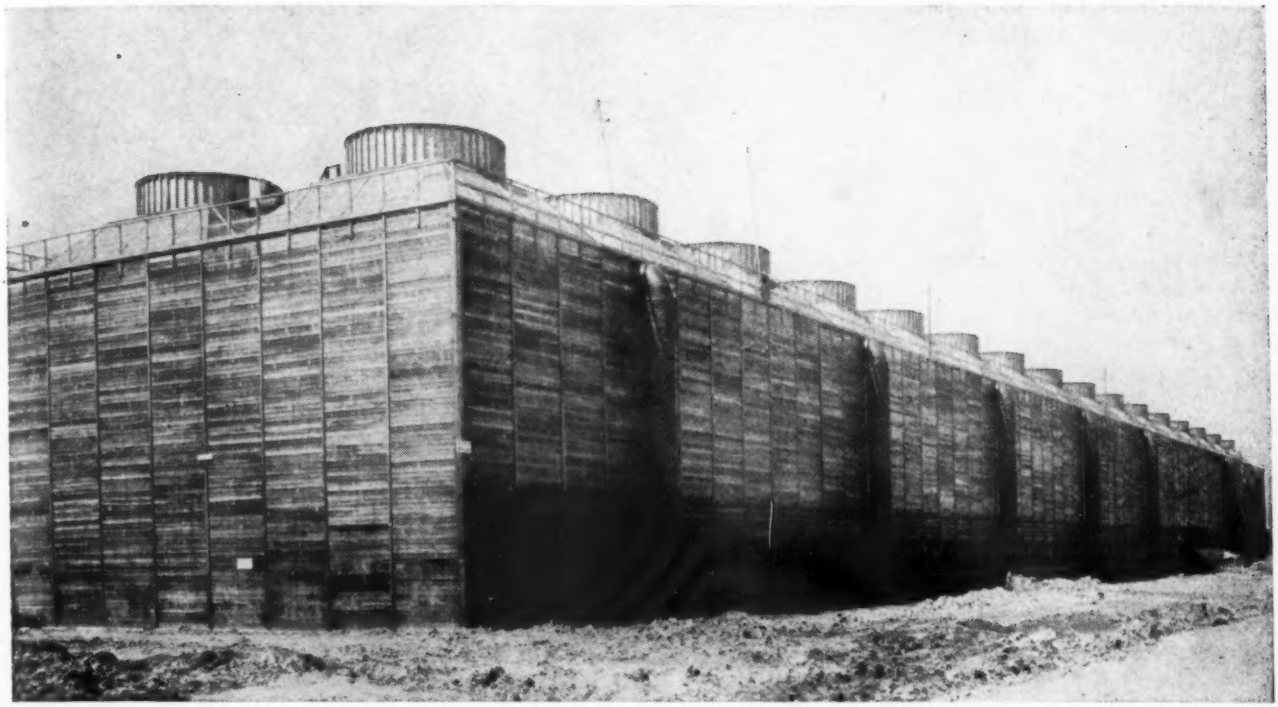


General view of a cooling tower that has 32 individual cells giving a capacity of 120,000 gpm. Any increase in height to which a pump delivers the required water in a tower creates additional operating costs for this work

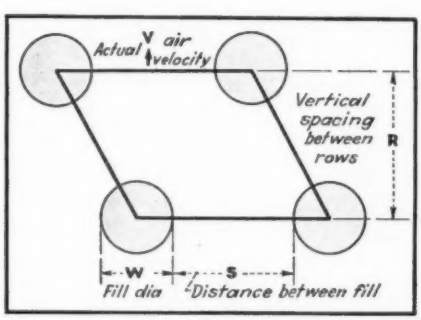
How the Cooling Tower Does Its Job

To help a purchaser understand what service may be expected from a cooling tower, J Lichtenstein*, Foster Wheeler Corp, explains the functions of its various mechanical elements

▶ IN DEVELOPING THE FUNCTIONS of a cooling tower's mechanical elements, let's first assume that not only does a purchaser choose a cooling tower to meet specifications for a given installation but also that units offered by manufacturers embody the best present-day practice.

With these assumptions as a starting point, we can build on the statement that a cooling tower is a heat exchanger. Essentially it is the surface that constitutes the product sold by the manufacturer. The tower with the largest surface offers the greatest assurance that performance will be accomplished if we make one further assumption: Except surface, all elements determining cooling-tower performance are alike.

So for the moment let us consider surface. In an ordinary heat exchanger, surface is a geometric factor. With most cooling towers today, however, surface consists of drop surface, and cannot be determined by measurement or test. Experiment gives us a product of surface and a coefficient of diffusion, but not each separately which is what we want.



Sketch of fill spacing shows that a large S gives a large number of rows per unit fall since total of fill shapes for all arrangements forms solid decks

The other factors that determine performance, such as air, its velocity and, correspondingly, the heat-exchange rate, pressure drop and power requirements, are readily available in a study of a manufacturer's proposal. Surface, however, requires at least some approximation to enable intelligent judgment of each tower's performance. To develop a method of approximation some consideration must be given to design principles of the tower filling that produces drop surface.

One method of determining drop surface is to provide a geometrically measurable surface, and let water run over it as a thin film while air passes upward in counterflow fashion.

Surface volume for cooling runs high and the expense of providing a sufficient amount by film type would be prohibitive. To provide a large material surface, early packed-tower design employed Rashig rings or similar devices. This design has been abandoned because, aside from the cost of rings, such designs imposed high power requirements to overcome the pressure drop of the air flowing through the tortuous

* Abstracted from a paper presented before the Midwest Power Conference, Chicago, April 1946.

path of rings. Further, water rarely covered the whole surface but tended to flow in channels, thus wasting much available surface.

Apparently the cheapest way to obtain a large water surface comes from dividing the water into many small drops by some means of atomization. The smaller the drops, the larger the surface. There is, however, a lower limit to the size of a drop, below which overall performance suffers. The air stream carries too small a drop out of the tower with it. To prevent such a loss would require a complicated eliminator system with an attendant high-pressure drop and consequent higher power demand. For this reason, water drops should be large enough to overcome the counterflowing air stream and fall into the tower sump. To give a satisfactory degree of water atomization, cooling towers do not require high-pressure nozzles. Water, dropping under the influence of gravity upon a splash plate, forms drops of suitable size.

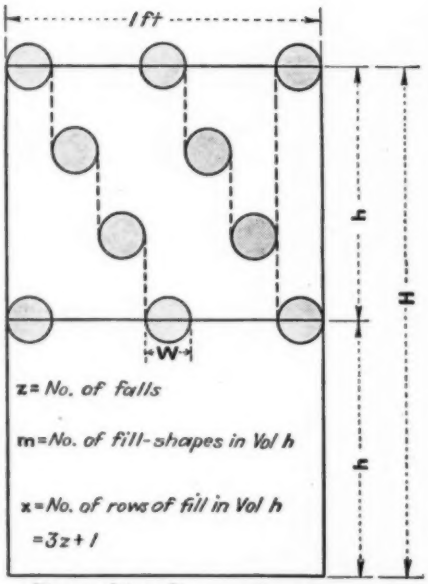
REGULATE TIME OF FALL

The act of dividing water into drops provides only one element in creation of surface volume. Total surface consists of the sum of all drops within a tower when steady conditions have been reached. This total number of drops depends upon the time of fall through the tower. In short, since the size of drops must stay above a certain minimum, the only other way of increasing the number of drops in a tower at a given time is to provide a longer time of fall. This item, time of fall, constitutes one control element for the designer with a tower of fixed height.

With early spray-tower design, drops fell freely through the tower so that tower height alone affected time of fall. Since high towers are expensive, height had to be kept low with the result that time of fall, and hence total surface, did not prove large enough for severe cooling conditions.

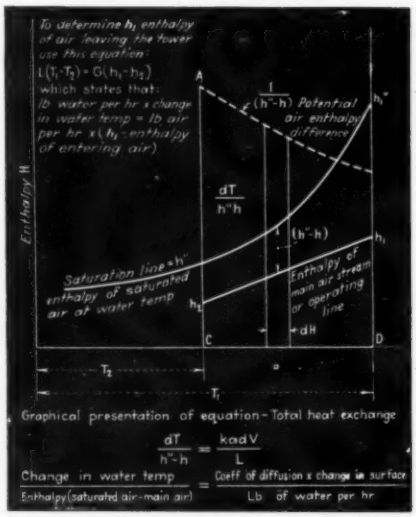
FILL IN A TOWER

Therefore, some method of increasing the performance of a tower of fixed height by increasing surface through a greater time of fall seemed necessary. To do this a tower is divided into a number of parts of equal height so total time of fall becomes the sum of times of fall for each height and larger than total time for the whole tower height without interruption. A modern filled tower consists, therefore, of a series of spray towers of similar height, one above the other.



Tower of 1 sq ft ground area

Ground area-unit illustrates the rule that all shapes within the selected volume when projected to the ground form a solid deck, or MxW=1 sq ft


To determine h_2 enthalpy of air leaving the tower use this equation:
$L(T_1-T_2) = G(h_2-h_3)$
which states that:
lb water per hr x change in water temp = lb air per hr x (h_2 = enthalpy of entering air)
Enthalpy H
Saturation line = h" enthalpy of saturated air at water temp
Enthalpy of main air stream or operating line
$\frac{dT}{h''-h}$
$\frac{1}{(h''-h)}$ Potential air enthalpy difference
$(h''-h)$
+dH
T_2
T_1
Graphical presentation of equation - Total heat exchange
$\frac{dT}{h''-h} = \frac{kadV}{L}$
Change in water temp / Enthalpy (saturated air-main air) = Coeff of diffusion x change in surface / Lb of water per hr

Combination of expressions for both heat streams, air and water, within a cooling tower leads to the above so-called cooling-tower equation for unit of temperature change and volume. In this form, the left side expresses the cooling effect of a tower, and the right side the elements mainly fixed by design, such as adV, the surface, a not readily determined factor. This right side can be called an expression for the tower characteristics. Graphical presentation gives total cooling over the whole tower fill, and is actually one step beyond the above equation. For any given case, all necessary factors are known: saturation curve h" between entering water T_1 and the cooled water T_2, entering air enthalpy, h_2, temperature range (T_1-T_2), lb of water L per hr, and lb of air G per hr. Operating line h_1-h_2 can be obtained from the relation outlined on curve. This gives the characteristic

Fill within a tower has for its purpose the task of preventing any drop from falling over a larger height than specified and of accomplishing this with as little pressure drop as practicable. It is not the purpose of fill to add film surface. It does add some by its presence, but little in comparison to drop surface. A good filling splits larger drops into smaller ones and is of such shape that no appreciable amount of water film forms. Only experimentation develops a fill that meets all these requirements. But a primary requirement is that no selected geometrical arrangement for a fill shape allow any drop to fall through a tower without the specified interruptions. This leads to the following principle: All filling within a selected volume, if projected on a plane parallel to the ground area, must form a solid deck.

A second important requirement for fill arrangement within a tower is that it present the smallest possible pressure drop to the counterflowing air stream. If the rows of fill are wide apart, these conditions occur (1) Number of rows per fall is large and vice versa. (2) Pressure drop is proportional to the number of rows and velocity head of air flowing through the fill shapes. Best arrangement requires placing fill shape on a center-line distance of three times the width of a fill piece. If a tower has z falls, total number of rows for the whole tower becomes $3z + 1$.

HEIGHT INCREASES SURFACE

Once filling layout has been decided and with it z, the number of falls, calculation will give the total time required for a drop to fall through a given tower. The laws of free fall apply since fall distance is so small that air resistance as a factor can be neglected.

Subdividing a spray tower of a given height into a number of spray towers of lesser height increases total fall time and, therefore, surface. First subdivisions produce sharp increases, but with more subdivisions the time gained becomes progressively less. Also, tower

(*Continued on page* 146)

CORRECTION

In "Fan Laws Simplify Performance Calculation," by R D Moyer, August 1946, p 78, the curves of Fig. 2 are mislabeled. Static pressure at 1000 rpm should be 1200 rpm. Upper horsepower curve should be at 1200 rpm, and lower horsepower curve, 1080 rpm.

THE OPERATING ENGINEER

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS—ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

Steam Giant Gives Way to Electric Power

Veteran of 45 years is about to retire in favor of more-modern electric drives. C B Hudson, chief engineer, of Plymouth Cordage Co, Plymouth, Mass., describes life history of a 1600-hp vertical corliss engine, which he has operated for over 25 years

EARLY IN 1900 a vertical cross-compound corliss engine, Fig. 1, was erected and put in service at the Plymouth Cordage Co plant in N. Plymouth, Mass. Built by the Dickson Manufacturing Co of Scranton, Pa., from a design by E. DeLeavitt, consulting engineer of Cambridge, Mass., the engine has been in constant service over 45 years. It drives a 3-floor binder-twine mill, and has operated most of its life on a full day-and-night run.

ENGINE CONSTRUCTION

With cylinder dimensions of 28½ and 64 × 54-in. stroke, the engine is rated at 1600 hp with throttle pressure of 165 psi. Its present load, however, is only about 400 hp, which it generates with 80-psi throttle pressure, atmospheric receiver pressure and 26-in. vacuum.

Both high- and low-pressure piston rods are 6¼ in. in diameter. Engine has a straight hollow-steel shaft with an 18-in. diameter in the bearings and 20-in. diameter in the flywheel section. The flywheel is built up from a double hub, each hub having a single casting with its bore tapering ⅛ in. per ft. Design drawings call for hub bore and shaft to be scraped to a fit within 4 in. of final location, the wheel being forced the remaining 4 in. to its permanent seat. Ten hollow cast-iron spokes are bolted to each hub. Outer ends of these spokes are bolted to the rim of the flywheel at points where each of its ten sections bolt together.

Driving Method. The flywheel, which has 71½ rpm, drives a head shaft on each of the three floors by means of 1½-in. manila ropes run through its grooved rim. There is a separate rope for each groove, Fig. 2. Generally the life of a rope is 15 years. Failure always occurs by unraveling at the splice. We have never known a rope to break clean.

Construction Details. All eight of the engine's corliss valves are located in the cylinder heads quite close to the center of the cylinder; hence the ports

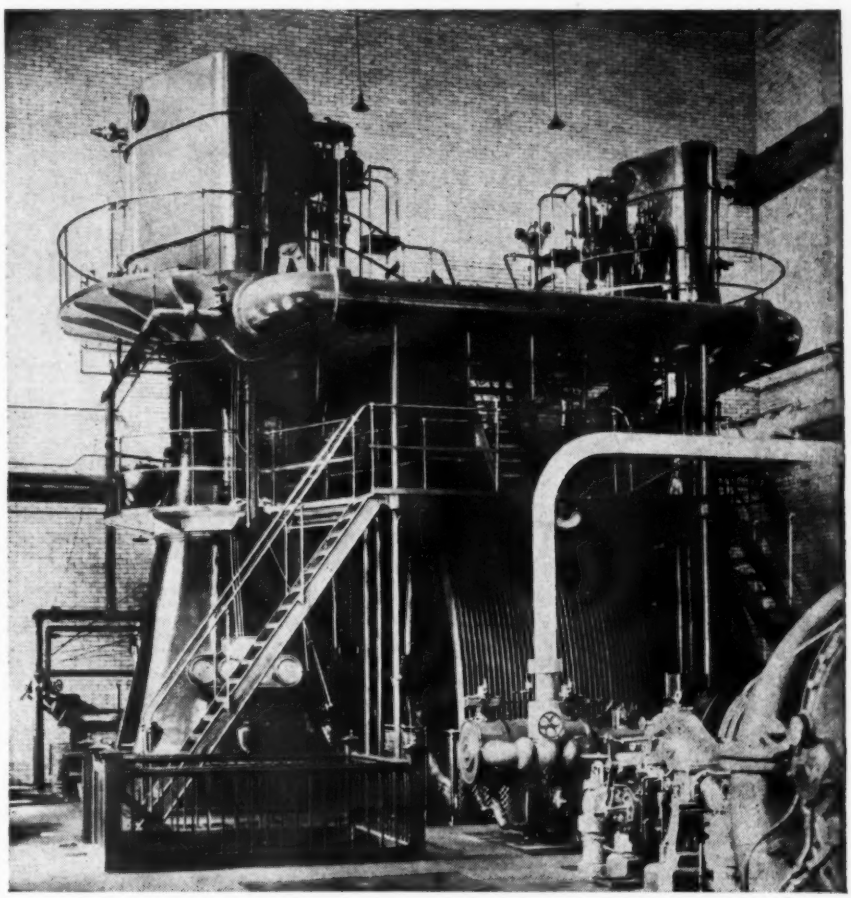


Fig. 1—Vertical cross-compound corliss engine, rated 1600 hp at 71½ rpm, has been in constant operation over 45 years driving a 3-floor binder-twine mill

Fig. 2—Chief Engineer Hudson inspects manila ropes that drive head shafts on three floors. Ropes last about 15 years, and fail by unraveling at splices

are short and the clearance volume small. Top high-pressure head is readily removable by disconnecting steam and exhaust-valve rods and governor link on that side of engine.

Cylinders and bottom heads are steam jacketed. High-pressure cylinder is jacketed at throttle pressure and low-pressure cylinder at about 30 psi.

Interior of low-pressure cylinder is readily accessible through a manhole in the top head. There is ample room inside to remove follower bolts, and to raise the follower ring and upper half of bull ring, after which the single 3-piece piston ring is readily removable. Packing ring in each cylinder is held against cylinder wall by half-elliptical springs, which bear against inner surface of piston ring and outer surface of bull ring. Bosses, cast on inner surface of the piston ring, keep springs properly spaced.

Wear on springs in the low-pressure cylinder required their replacement for the first time a few years ago. Since the builders had retired from business, our plant-maintenance department forged and tempered springs.

We searched in vain in several mechanical-engineering reference books to find data on packing-spring design. We finally computed total bearing area of packing ring in square inches. We divided this result by the number of springs to give the area in square inches per spring. Springs were then made to exert a pressure of 6 psi between packing ring and cylinder wall at maximum deflection of ¾ in. These have proved entirely satisfactory in their performance over a period of several years.

Performance. The unit operates condensing, and is served by a steam-driven twin vertical walking-beam wet-vacuum pump with 12-in. steam cylinders and 25-in. water cylinders with an 18-in. stroke. The Blake Pump Works of Cambridge, Mass., built this pump with accompanying condenser chamber.

High-pressure packing, which is Tripp metallic, has been renewed only three times during the life of the engine, and so far as anyone knows the original set of U. S. metallic packing is still in service in the low-pressure packing box. It is still tight and has never been out, a truly remarkable record.

Cylinders have been inspected yearly for the past 25 years; at the inspection in August 1945 a .003-in. feeler gage could not be inserted between the packing ring and the cylinder wall at any point. Liberal lubrication has held cylinder wear to a minimum, and boring-tool marks are still visible in both cylinders.

The 10-in. throttle valve is made entirely of cast iron, even to its renewable seat and disk. These have never been replaced and are still steam-tight.

About 30 years ago a 1½-in. follower bolt head broke off and turned edgewise between the piston and high-pressure cylinder head. Only damage was a flattened bolt head, which now equals the clearance dimension between piston and cylinder head. Needless to say, the piston and head still bear the impression of the bolt head.

ENGINE OPERATION

Increased motorization in the mill has decreased engine load to 400 hp. Throttle-steam temperature is therefore limited to 400 F. Steam temperature is decreased in a thermostatically controlled desuperheater since it is generated with considerable superheat for our two turbines.

Last 26 Years of Operation. Some time after the engine was erected the setting of the exhaust eccentric on high-pressure cylinder was advanced 2½ in. beyond the original position. As a result the compression was so high the crosshead was lifted off its bearing guide each stroke and forced against the opposite side. Since total clearance between shoe and guide was considerable this movement of crosshead caused a severe pounding at both ends of stroke.

We located the old shop marks indicating the proper position of eccentric on shaft. The eccentric was moved back to its original position and pounding

stopped immediately without difficulty.

Fig. 3 (*a*) shows a set of high- and low-pressure cards taken for horsepower computation on Aug 12, 1920 when the load was about 1300 hp. Throttle pressure was 150 psig, receiver pressure 8.5 psig, and backpressure 26-in. vacuum.

Fig. 3 (*b*) shows cards that indicate what can happen unless care is taken to assure accurate reassembly when valves are dismantled for inspection. The first card was taken on Monday morning after a weekend inspection. It was our routine computation of ihp. Compression line indicates that something is wrong. Maintenance men, who reassembled the valve gear, stoutly insisted that all parts had been correctly assembled.

The engine was allowed to operate until noon when it was shut down, and the back bonnet removed, which showed that exhaust value was 180 deg out of position. The valve was withdrawn and turned to proper position. The second card shows return to normal operation.

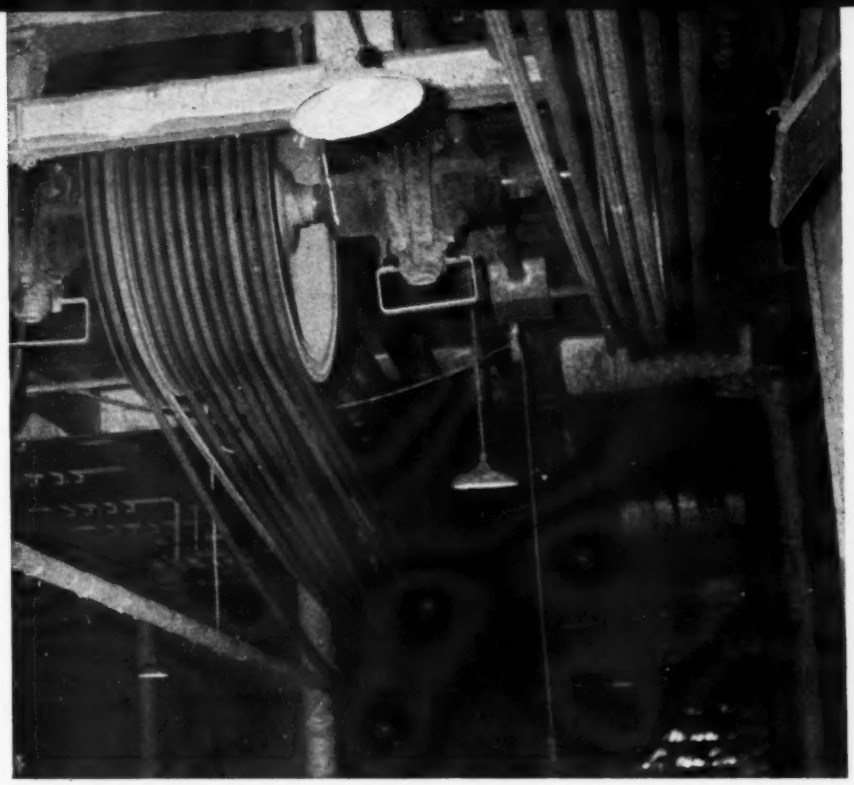


Fig. 4—Power-consuming head shafts like these throughout the mill are partly responsible for replacing of one large central drive with individual motors

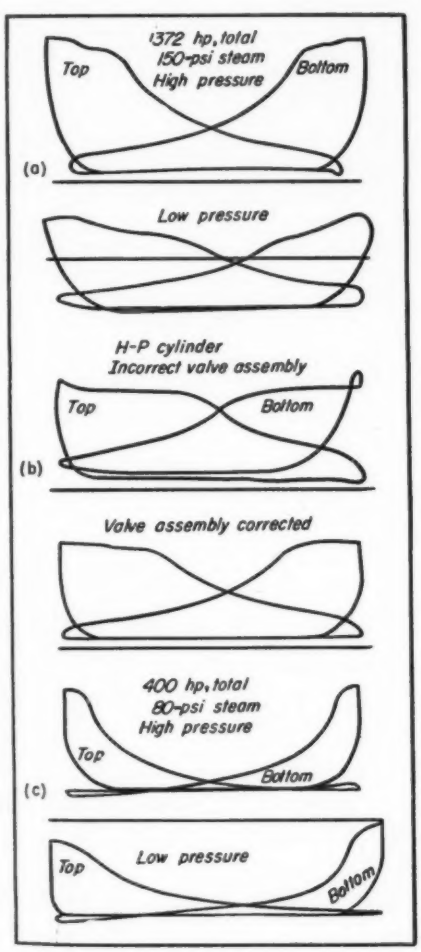


Fig. 3—Indicator cards show performance of engine for the past 26 years. Comparison of (a) and (c) indicates a reduction of load during this time

Fig. 3 (*c*) is a set of indicator cards taken recently under normal operating conditions. Comparison of (*c*) with (*a*), taken Aug 12, 1920, shows what is happening to the load for this 45-yr-old veteran.

Difference between ihp of the two sets of cards indicates that the plant is now about 75% electrically operated. Electrification will be completed as soon as equipment is available; then the steam-giant will be retired.

Throttle pressure has dropped from 150 to 80 psig. Indicator expansion loop indicates that throttle pressure can be further reduced, but other uses for steam from this line require that this pressure be maintained. Receiver pressure is maintained at about 0 psig, which is ample to equalize the load on both cylinders.

Some surprise may be expressed by the fact that initial pressure on top end of low-pressure card does not come up to pressure on bottom end. Our guess is that steam is pretty "thin" and has to travel vertically six feet and make two right-angle turns to get into cylinder because the pipe from the receiver enters steam chest at the bottom of cylinder close to bottom inlet valve. Therefore, pressure drop between receiver and cylinder at valve opening is not so great at the bottom as at the top.

We have no way of knowing definitely what the guaranteed steam rate per hphr was. It has been as high as 12 lb per hphr with a throttle pressure of 165 psig at various times during operation.

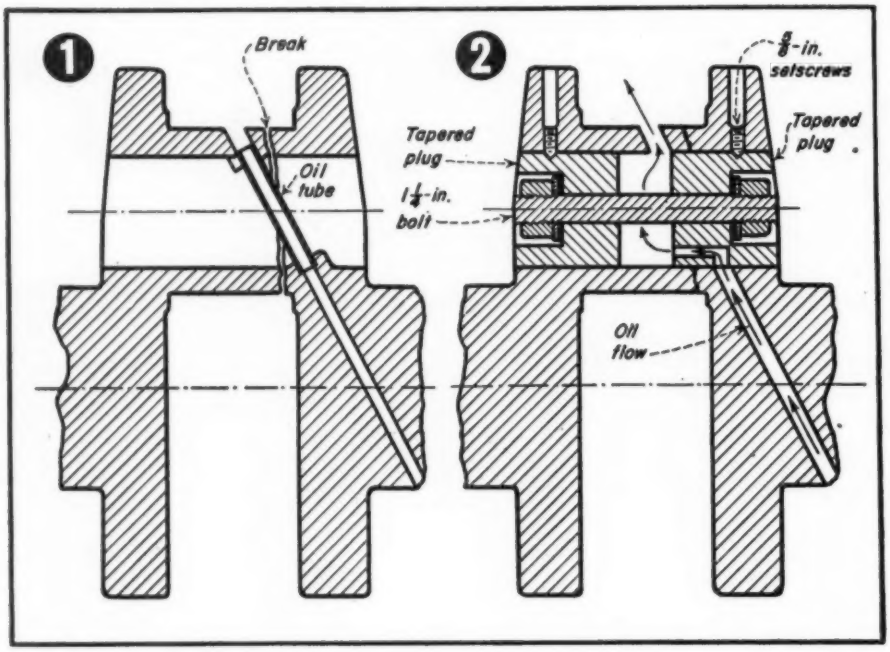
Engine Retires. The mill is changing from 100% binder twine to other products. Therefore, installation of more-compact spinning machinery with greater production per man-hour is partly responsible for retiring the engine since this type of machinery is more adaptable to modified group drive by motor. This eliminates long lines of heavy shafting with resultant power loss. The change also results in more flexible operation when curtailed production seems desirable, or when a second shift is operated at partial production because full operation of one shift does not meet production demands. In this case engine drive requires operation of long lines of shafting partly loaded.

There will be a considerable saving in total friction load because of engine friction, and windage loss of flywheel, ropes and head-shaft pulleys, Fig. 4. Elimination of cylinder-jacket steam during periods when the engine is idle will also be a factor in saving.

It is expected that within a year operation will cease for this veteran, which has seen the development of the steam turbine from swaddling-clothes to the full-grown giant it is today. To those of us who are now old timers its passing will be regretted. Although we are in line with modern methods of power generation and application, sentimentally we love the smell of warm cylinder oil and the sound of softly dropping dashpot pistons, which are associated with old-time reciprocating engines.

Plant-Tested Methods and Ideas for Power Men

PRACTICAL Aids to Operation



AN UNUSUAL REPAIR MADE ON CRANKSHAFT

RECENTLY I INSTALLED a new crankshaft in a 450-hp diesel engine driving an auxiliary generator on board ship. When the old crankshaft was taken out I found that W W Forbes, chief engineer, had done an excellent repair job on it. The drawings show where the crankshaft failed and how it was repaired at sea. Failure occurred at the forward end of No. 1 crankpin.

Heads were removed from cylinders No. 1 and 2. Piston and connecting rod were taken from No. 1 cylinder, and No. 2 connecting rod was released and swung out of the way. These were the only parts removed except No. 1 and 2 crankpit side plates.

The hollow-crankpin bore, Fig. 1, was ground out with an outward taper of ¼ in. per in. at each end and plugs made to fit these, as in Fig 2. Weight of the plug assembly was calculated and straps secured to the crank web to balance the shaft properly. To provide lubrication to the connecting-rod bearing the oil passage in the crank was changed from that in Fig. 1 to the arrangement in Fig. 2. After the plugs had been pulled home with the 1¼-in. bolt they were locked in place with two ⅝-in. setscrews in each web of the crank.

When the engine was put back into service, Mr Forbes said it was first run slowly for 30 min and found to operate satisfactorily. It was then run up to 450 rpm and again found OK. The governor was adjusted for 475 rpm and the engine operated at this speed for 10 min. After this the engine was carefully checked, the governor reset for 450 rpm, and the engine run for 2 hr, one of which was at full load.

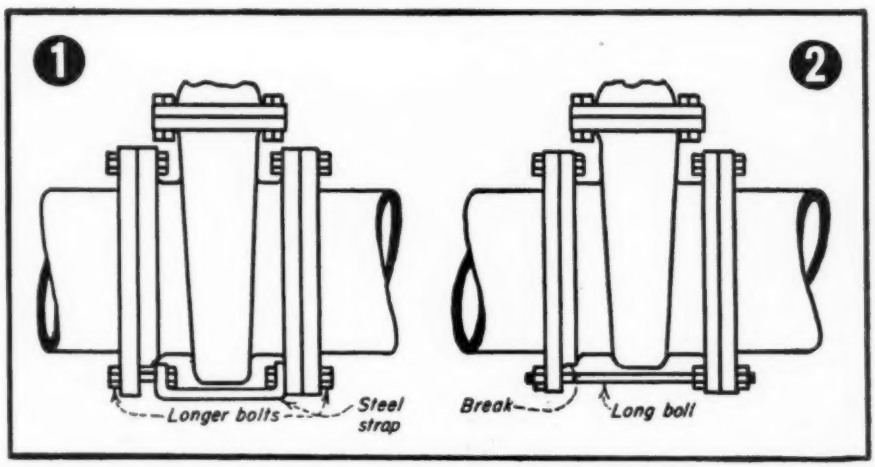
Everything being satisfactory, the unit was shut down, the oil drained, the crank pit cleaned, and a change of oil put in. After this the diesel engine again went into regular service for the remainder of the voyage.

Brooklyn, N. Y. STIRLING CAMERON

Temporary Repairs on Broken Valve Flanges

CAST-IRON VALVES with raised-face flanges or ring gaskets sometimes have their flanges broken because of improperly tightened bolts. Since a spare valve is not always readily available something must be done to keep the old valve in service. Diagrams below show methods that I have used to keep a valve in service with a broken flange. In Fig. 1 a heavy steel strap makes the connection around the valve. Dimensions vary for different valves but the strap is easily made.

Fig. 2 shows a method used with some valves that have very little body bulge. Make a bolt, threaded on both ends, long



enough to reach through the two flanges. Sometimes it may be necessary to bend the bolt slightly for it to pass the valve's body.

Such repairs are not recommended for high pressures and temperatures, or where pipeline stresses are severe. Be careful to distribute load evenly on all flange bolts.

Bellingham, Wash. DEAN H BERGMAN

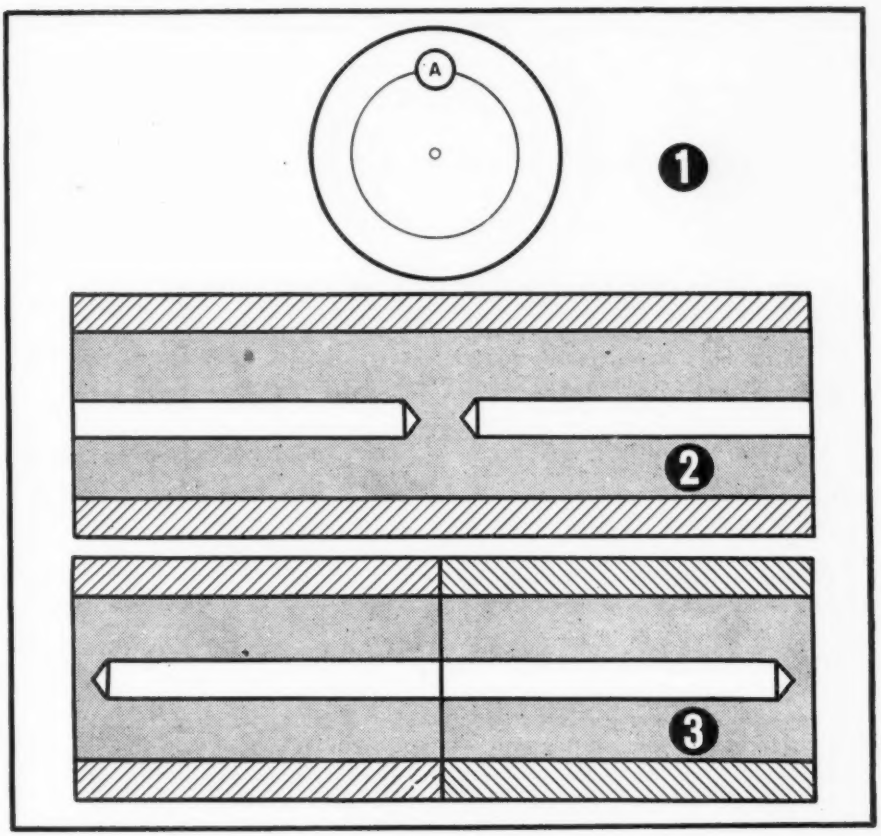
Drills Oil Grooves In Long Bushing

I HAD TO MAKE a long bronze bushing for a loose pulley on a shaft. This bushing required an oil groove running nearly its full length, but closed at each end. Drawings, right, show how I did this job. First, I carefully located the center in each end of the round stock from which the bushing was to be made. Then I drew a circle the diameter of the bushing's bore at each end and on this located the centers for boring the oil grooves, as at *A*, Fig. 1. The grooves were bored in from each end almost to the center of the bushing stock.

I then bored and finished the bushing to size, after which the oil groove looked like Fig. 2. To complete the job I cut the bushing in two and put the two outer ends together. This made the oil groove continuous, as in Fig. 3, but closed at its outer ends.

When putting the bushing in the pulley hub I pressed both halves in from the same end. One half was pressed flush into the hub; then the second half was placed against the first and the two pressed home. In this way the two halves of the oil groove could be kept in line.

Leeds, England H MOORE

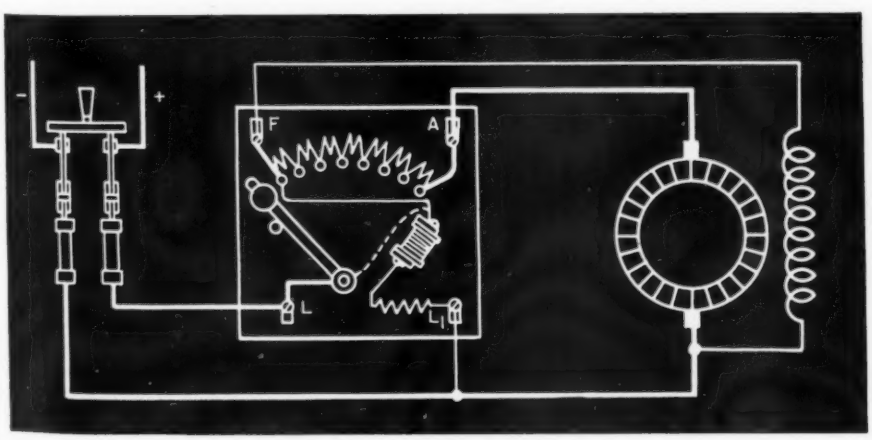


CHANGES IN STARTING BOX REMOVE TROUBLE

WE HAD TROUBLE with a dc-motor starting box because of moisture conditions where it was installed. This starter is a 4-terminal design with the no-voltage release coil connected across the line, as in the diagram. With this connection the coil is in circuit only when the starting arm is on one or two of the starting-resistance contacts.

We decided that this coil and its resistor would supply sufficient heat to keep the starter dry if left in circuit continuously. This we did by disconnecting the no-voltage release coil from the first point on the starting resistance and connecting it directly to the starting arm as indicated by the dotted line. With this connection, as long as the motor switch is closed the coil and its resistor are energized. This change, plus inclosing the starter in a box, eliminated insulation failures due to moisture, which previously had been troublesome.

Lancaster, England W M GORE



Safe Combustion of Fuels Burned In Suspension

GAS THAT FORMS from delayed or interrupted ignition may cause a furnace explosion, either when gas is used as a fuel or when gas is distilled from coal or oil fuels. Dust explosions usually follow a gas explosion. Safety program should include:

1. Positive means of burner ignition is essential. An electric spark may be used with small oil- or gas-fired heating boilers; an ample torch is necessary for larger units. A stack switch for the former and a flame detector for the latter are desirable. In larger pulverized-coal plants, the draft fans and pulverizer should be interlocked so starting and shutting down in proper sequence are

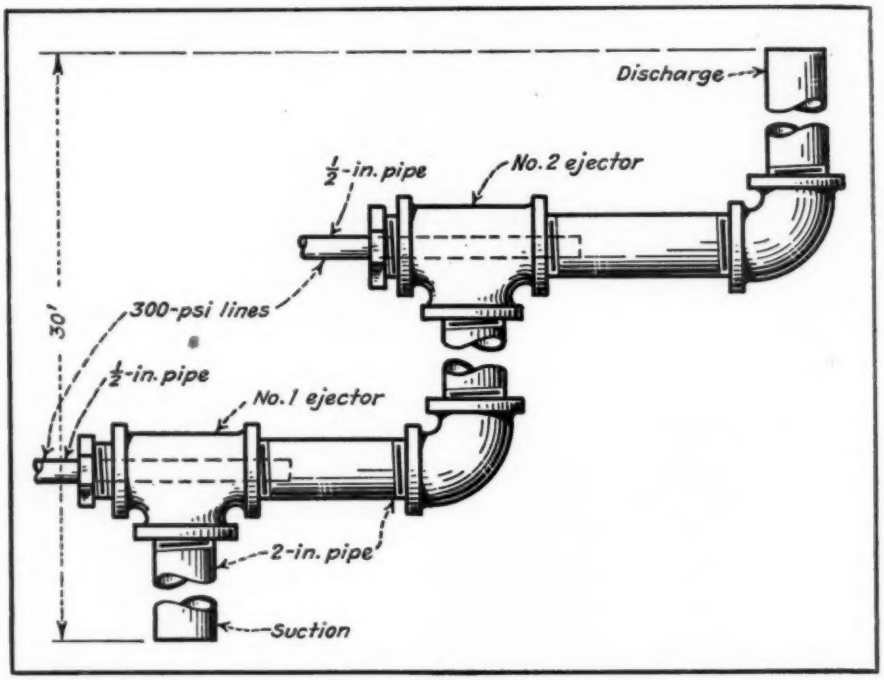
assured. Instruments and gages to indicate general conditions are necessary. Lock open dampers or remove tight-fitting ones if used. Do not latch or brick-up explosion doors.

2. Before lighting up all but small automatic-heating boilers ventilate the furnace with full draft and with the damper wide open. Hold a torch flame directly in front of burner using a rich fuel mixture. Light only one burner at a time. With oil burners have oil temperature high enough to sustain combustion. After attaining stable ignition the torch may be cut off and normal fuel-air ratio established.

3. During operation the greatest hazard is neglect. Give heating boilers frequent attention, even though automatically controlled. Do not leave power boilers unattended while in service. Low loads with a change in fuel-air ratio, may cause unstable combustion. Keep up level in fuel-oil tanks to avoid drawing water or sludge from their bottoms. If the flame fails, shut off fuel and ventilate the setting with full draft before starting again. Always use a torch flame; never attempt ignition from an adjacent burner or a hot furnace.

4. To shut down with oil or gas, shut off the burners and leave the dampers open. With pulverized coal, stop the feed and operate the exhauster on unit pulverizer with dampers wide open until the system is free of fuel.

Canton, Mass. HARRY M SPRING

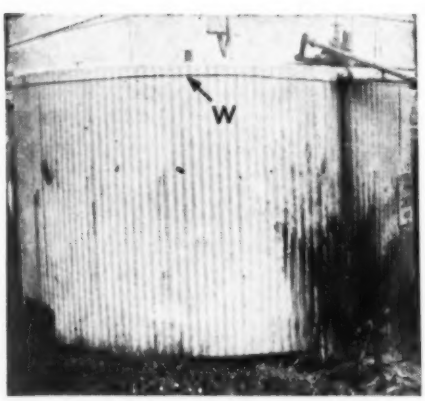


EJECTORS SERVE AS EXCAVATION PUMPS

DURING CONSTRUCTION of a steam plant, foundation-pier excavations had to be unwatered continuously until the concrete was poured. When foundation work was started neither steam nor compressed air was available for operation of unwatering jet pumps, nor could a motor-driven pump suitable for the job be obtained. Water at 300 psi supplied by a centrifugal pump for sinking piles was used in ejectors made of pipe fittings.

Two jets were required in tandem, with the discharge of the lower one piped into the suction of the top one, as in the diagram. No doubt these were very inefficient when the water horsepower represented by the water removed from the excavations is compared to the power input to the 300-psi centrifugal pump. But the main object was to keep the water out of the excavations until the foundations were poured and the ejectors did this work effectively.

Cincinnati, O. H B MCDERMID



Corrugated Jacket Aids Oil-Tank Heating

A SIMPLE, INEXPENSIVE METHOD was used by one company to heat its fuel oil tank. A corrugated iron jacket was placed around the tank, extending from the ground to the tank's top. Wire *W* near the top of the jacket secures the corrugated iron to the tank, which rests on feet to support it about 10 in. above ground. This space permitted installing a small gas burner under the center of the tank's bottom, with which to heat the fuel oil.

Air heated by the burner passes across the bottom of the tank and up between its sides and the corrugated jacket. By this means the heat from burning a small amount of gas keeps the oil in a state of fluidity so it flows readily.

Pomona, Calif. G M WILSON

Care and Installation Of Compressed-Air Tanks

AIR TANKS of improper construction and those operating under undesirable conditions have constituted sufficient hazard for a number of states to enact air-tank regulations.

1. Have tank large enough to supply air demands without excessive pressure fluctuations. The construction, manufacturer's stamping and installation must comply with local requirements. If there are no local laws for air tanks, select a tank constructed in accordance with the ASME *Code for Unfired Pressure Vessels* and stamped for the desired pressure. Do not use range-boiler hot-water tanks for compressed-air receivers.

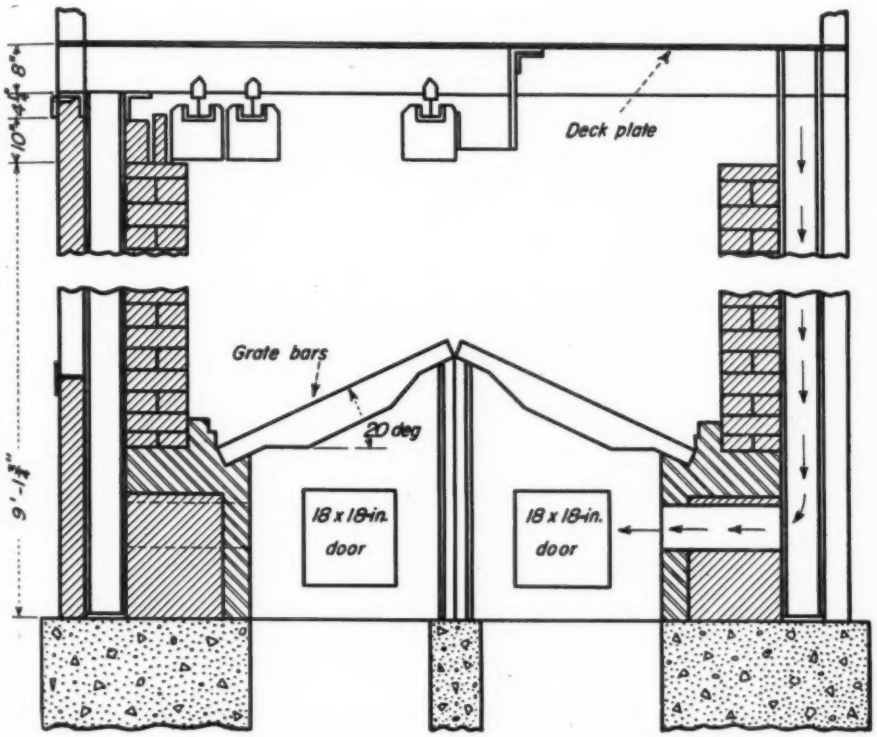
2. When tank is vertical have the lower head dished outward to permit proper drainage and mounted on an open base to permit proper inspection. Have all external surfaces and inspection openings accessible. Provide the compressor with clean, cool air and install discharge piping as direct as possible to the receiver. Sharp turns or inadequate support may cause pulsation in piping or tank.

3. Provide a safety valve stamped "ASME Standard," or in accordance with local requirements. Install this valve on

the compressor discharge or on the receiver. It should have a relieving capacity at least equal to the compressor-discharge capacity. If there is a shutoff valve in the compressor discharge line, protect the compressor with a safety valve between it and the valve. Set the safety valves at a pressure not over that allowed on the tank.

4. Proper maintenance consists of periodic drainage of oil and condensate, and cleaning and protecting all surfaces from corrosion. Do not use gasoline for cleaning. Use carbon tetrachloride as an oil solvent applying it with a longhandled brush from outside the tank. Do not let a workman apply an oil and dirt solvent while inside the tank because its fumes are dangerous.

Canton, Mass. HARRY M SPRING



PYRAMID GRATES FOR WOOD BURNING

WOOD REFUSE, such as sawdust, hog fuel and shavings, burns best in dutchoven furnaces. Many oven and furnace designs and grate arrangements have been developed for these fuels. Some grate arrangements pyramid in the oven, while others slope to front or rear. The pitched grate in the figure was designed after studying several boiler plants with different boiler designs.

The pyramided grates eliminate the fuel cone, such as exists on a flat grate, give greater free-air area under the grates, and consequently increase the combustion rate. An increase in grate area is obtained with only a slight increase in construction cost over a flat grate.

The grates were set at a 20-deg pitch in the dutchoven, as shown, on a 2500-sq ft Heine watertube boiler. Two feed holes are provided directly above the grates' comb. As the fuel falls on the grates it rolls gradually to the oven sides thus permitting the whole fuel bed to ignite. Under test, boiler efficiency was substantially increased compared to that obtained with flat grates. For best results fuel should flow to the oven at a rate that keeps the grates covered to a depth of 8 to 10 in. This grate design is now in operation at the U. S. Naval Air Station, Klamath Falls, Ore.

Eugene, Ore. HOWARD J HOUSER

Rotor End Thrust Shifts Brush Assembly

A LARGE WOUND-ROTOR INDUCTION MOTOR gave trouble because its sliprings shifted on the rotor shaft so the brushes did not ride squarely on them. I shifted the ring assembly back into its original position, but in a week or two the rings were out of line with their brushes again.

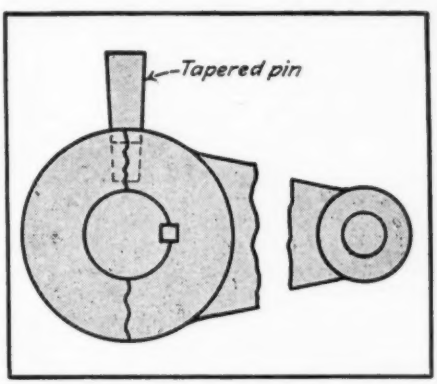
Checking the end play of the motor's rotor I found that when the rotor was centered and the motor started, the rotor pulled hard over toward the rings. This indicated that the rotor core was off center with the stator core. When the motor was running its rotor pulled endwise far enough for the ring assembly sleeve to hit the bearing and shift the former. The problem was solved by leaving the rings in the new position and shifting the brush holders so the brushes ran squarely on the rings.

Fortunately, the ring assembly shifted to let the rotor center in the stator's magnetic field. If the rings had not shifted the sleeve that they are assembled on would have rubbed with sufficient force on the bearing to cause overheating.

Philadelphia, Pa. R O SPENCER

Splits Lever Hubs For Easy Removal

TO RECONDITION the gate-control rigging on a 1000-kw horizontal-shaft waterwheel several crank levers had to be removed from gate-control shafts. This unit had operated under water for several years and as a result these shafts and their crank levers were badly rusted and corroded. From all appearances the levers would be difficult if not impossible to pull off their shafts. A puller was not available and it would have been difficult to use one because the crank-lever hubs were set close to bosses on the waterwheel cover plate.



The unit had to be put back in service as soon as possible, so without wasting time in building and experimenting with a puller the erecting engineer went to work using a method that he knew would work. With an electric drill he drilled a row of 3/8-in. holes across one side of the lever hubs, and drove taper pins in them, as in the diagram. In a short time the hubs cracked open leaving the shaft clean and ready for the new levers.

Cincinnati, O. H B MCDERMID

READER'S PROBLEMS

Exercise your engineering wits by submitting answers to these questions fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

1—How Do You Keep Sediment Out of Ice?

OUR 1500-LB ICE PLANT makes 30- to 50-lb blocks, 4x15x30 in. The ice cools drinking water for hospital patients. Complaints have been coming back that when the ice melts it leaves a deposit or white sediment.

I have tried everything I can think of to correct this condition. I have been experimenting with air, but thinness of blocks makes this difficult. Will POWER readers suggest some remedy that will be helpful in eliminating sediment? We have good water; therefore, why should a deposit form?—RAK

2—What Burns Spots On Generator Sliprings?

WE HAVE HAD considerable trouble with burned spots developing on the sliprings of a 500-kva 440-v 3-phase 60-cycle 450-rpm alternator. The rings have been resurfaced and the brushes changed without finding a permanent cure. Smoothing the rings stops the sparking for a short time, but the trouble gradually returns. Our plant is at an elevation of a 5400 ft, but I see no reason why this should cause trouble.

Someone suggested changing the polarity, but I fail to see how this would stop the rings from burning.

Probably some POWER readers, who have experienced similar trouble, have found a cure for it. At least I would like them to describe their experience and tell me the most likely causes for burned spots on sliprings.—ACN

Editor's Note: *Every month several good answers cannot be published because they arrive too late to meet our deadline.*

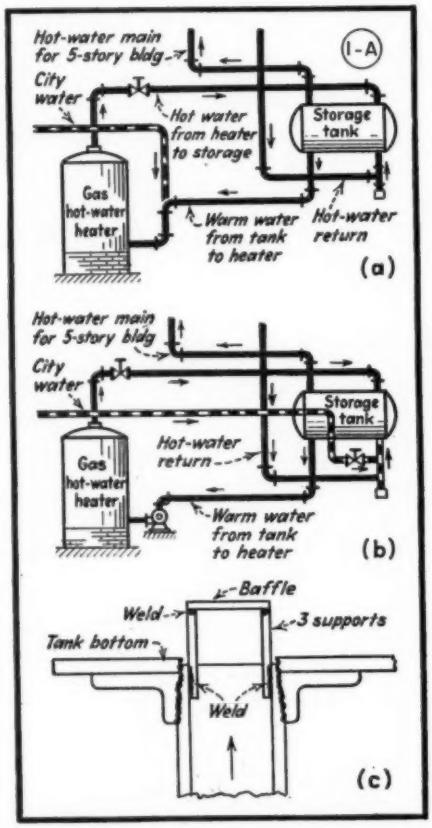
Give your answer a chance; be prompt with your reply. All answers that reach us before the 22nd of October will receive consideration for the next issue. Let yours be among them.

Answers to August Questions

ELB Wants Pointers on a Better Hot-Water System

(This is Question 1 from the August issue, with best answers from readers.)

We have trouble maintaining hot water upstairs in our hotel about an hour after the demand starts in the morning. Our heating and circulating system is shown in sketch Q-1, on the facing page. The heater seems to have enough capacity but the hot water doesn't circulate fast enough to keep an adequate supply.



I plan to add a pump to the circulating system as shown in sketch Q-1. Will POWER *readers tell me whether the pump as added will solve the problem? Should I make some changes in the present piping arrangement?*

Would my system work better if the cold water entered the heater instead of entering the storage tank as shown? At present the cold water enters the storage tank with the return. Does this tend to dilute the hot water? If this is true, why does the system give water that is too hot for the first hour and fail during the rest of the day?—ELB

Avoid Mixing the Hot and Cold Water

IF THE HEATER has enough capacity it can be fully utilized by reconnecting water supply to inlet of heater, (a) sketch 1-*A*. As originally connected, cold water is brought into tank and mixed with hot water, thereby reducing its temperature.

If flow through tank is heavy, velocity of incoming cold water may carry it up into storage tank causing unnecessary mixing and loss of effective hot storage capacity. A baffle over cold-water inlet, (c), will reduce excessive mixing.

Inasmuch as *ELB* has not mentioned pressure loss, a pump appears unnecessary. In the location he proposes it could do nothing except increase circulation through the heater. If the pump were connected to circulate water through both tank and heater as in (b), its operation would level out temperature difference between tank and heater, and increase heater capacity.

Piney River, Va. I A BUTCHER

Change the Piping

IF ELB HAS NOT PURCHASED a pump for circulating I suggest the piping change in sketch 1-*B*. I believe his trouble comes from cold water mixing with hot at time of greatest drain. *ELB's* system shows cold-water line entering tank di-

rectly under outlet for his hot-water supply from heater. At periods of low consumption, no doubt there is ample time and space for the cold-water makeup to be heated. The inrush of cold water caused by drain on hot water results in mixing of cold and hot water, which gives only about an hour's supply in the morning.

E O'BRIEN
Springfield Gardens, N. Y.

Use Circulating Pump

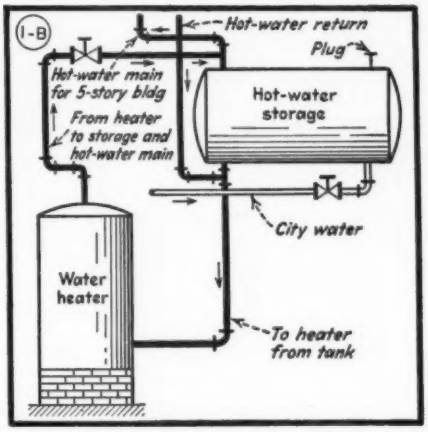
INSTALLING A CIRCULATING PUMP, as *ELB* proposes will provide water nearer storage-tank temperature at the more distant outlets. This reduces waste caused by running out cold water.

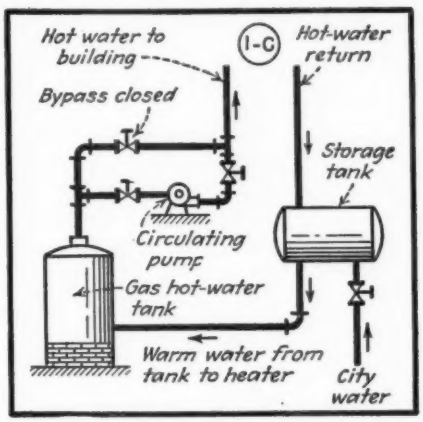
If *ELB* installs a circulating pump, 1-*C*, he will retain this advantage and also increase heat-transfer capacity of his system. Water to outlets will be under direct control of heater regulating controls instead of somewhere between the heater water and the combined temperature.

Bronx, N. Y. H H DEMLING

Piping Changes Improve System

INSERT A TEE in the line from heater to storage tank and connect it to hot-water main, (a) 1-*D*. If water is hotter in storage tank it flows to main; if not, heater feeds the main directly. When there is no draw of hot water, heater transfers hot water to storage tank direct. Line from storage tank to heater should be changed to come out of tank center (b). When there is a heavy draw of hot water, cold water rushes into storage tank. This throws a heavy load on the heater when hot water is most needed. Check heater to see that both water and heating surfaces are clean. A safety valve should be attached to





storage tank at (c) and one on heater at (d). Install a check valve on cold-water inlet to storage tank so, if water gets too hot, it will close and check flow into cold-water system.

Bronx, N. Y. GEORGE GRIFFEL

Provide a Mixing Valve on Each Floor

ELB's TROUBLE is not with the design of his hot-water system, but its' incompleteness. This type of system should have a mixing valve on outlet of each floor, 1-*E*. This may be set for 110 or 120 deg, more or less, which would eliminate the extreme amount of "too hot" water wasted to the sewers daily. System capacity is no doubt overtaxed during rush periods, and the only way to relieve this condition is to cut out the waste. Recirculating line will have to connect behind mixer valves. Slop sinks should also be connected behind mixer valves so they will have water at heater temperature.

Buffalo, N. Y. T B BREEN

Diluting Hot Water Causes Trouble

A HOT-WATER SYSTEM which gives water that is too hot usually has poor circulation between tank and heater.

Rapid cooling during heavy demand can result from (1) dilution of storage by cold inlet water and (2) flow reversing through hot-water return lines. This is caused by pressure drop to faucets and is aggravated when return is connected to cold-water inlet.

A check valve should not be used to correct this condition because it interferes with natural circulation.

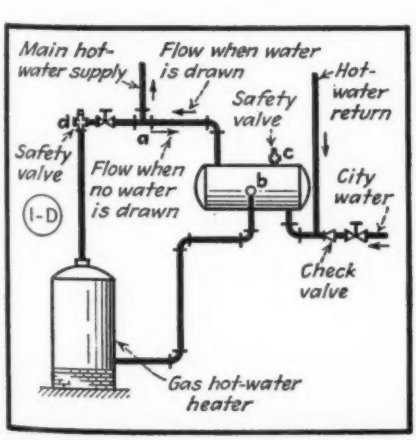
A pump should not be necessary in *ELB's* system because there is no difficulty getting hot water at start of demand. If his troubles persist after making changes in 1-*F*, he could close a valve on the hot water return, to prevent reverse flow during heavy demand.

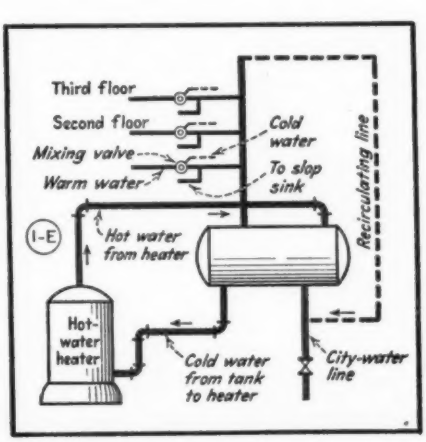
Sarnia, Ont. L B KILBREATH

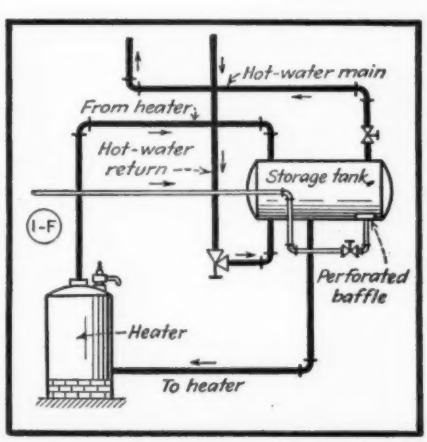
Circulating Pump Doesn't Solve Difficulty

THE PROPOSED CIRCULATING PUMP will not solve *ELB's* problem. It will speed up circulation, but by returning hot water to the storage tank along with cold water he will not gain the full effect of the circulating pump.

I suggest *ELB* hook up his hot-water







return line to the circulating-pump inlet and run the pump discharge direct to water heater. He should install a control on hot-water return with a gate valve and check valve ahead of it. This operates the pump automatically and should be set at minimum temperature differential so it operates frequently. Connect hot-water return to storage tank in the line between pump discharge and water heater as in sketch 1-*G*. A venturi tube at this point helps pull cold water from storage tank to heater, (*A*) of sketch.

For best results cold-water connection should enter storage tank at top with pipe extending inside tank to within 2 in. of the bottom. This causes cold water to stratify along tank bottom, where it has less effect on hot-water temperature. Bottom of storage tank should be at least 12 in. above top of heater for best efficiency with gravity circulation.

I also suggest that hot-water line from heater be tied into storage tank on the side or end about three-quarters of the way up near hot-water outlet.

ELB should install a hot-water limit control in the end of storage tank to control operation of gas burner. This control should be set at temperature desired in storage tank.

Des Moines, Iowa S R HIGGINS

System Is Large Enough If Properly Adjusted

ELB INDICATES THAT his system as a whole is large enough for total demand, but the rapid drop in water temperature indicates that reverse circulation occurs, mixing his hot and cold water. A circulating pump would correct this condition; however, it would have to operate 24 hours a day.

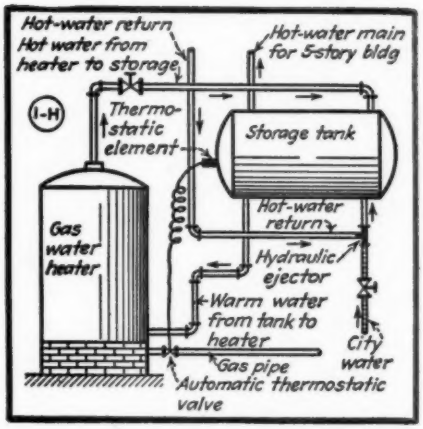
By placing a hydraulic ejector, 1-*H*, even a slight demand will increase circulation. When demand stops, gravity circulation will still continue.

An automatic thermostatic valve as shown is desirable in the gas line to the heater. With thermostatic element in the storage tank it regulates gas supply and keeps water temperature constant.

Kingston, Ont. W J SUTHERLAND

Heater Is Too Small

I BELIEVE ELB's gas water heater is not large enough to care for maximum demand. The fact that water is too hot the first hour indicates that heater (1) has no temperature control and (2) has had a chance to heat water in storage to a high temperature before demand started. A thermometer in the hot-water line from heater to storage tank would



show temperature maintained during maximum demand. City-water should be connected into warm-water line ahead of tank and not into return line.

Dorchester, Mass. W F O'REGAN

Use Circulating Lines

EVIDENTLY MOST OF ELB's TROUBLE is lack of circulation. Water-temperature drop, an hour or so after demand becomes normal or slightly over, proves that circulation is not adequate to supply all parts of system.

Sketch 1-*I* shows system rearranged to eliminate difficulties. Number of circulating lines will, of course, depend on building conditions. Pipe size of circulating lines can be considerably smaller than regular hot-water leads. Shutoff valves should be placed on all circulating lines so they can be closed in case of line failure. Segregating valves make each line independent of others.

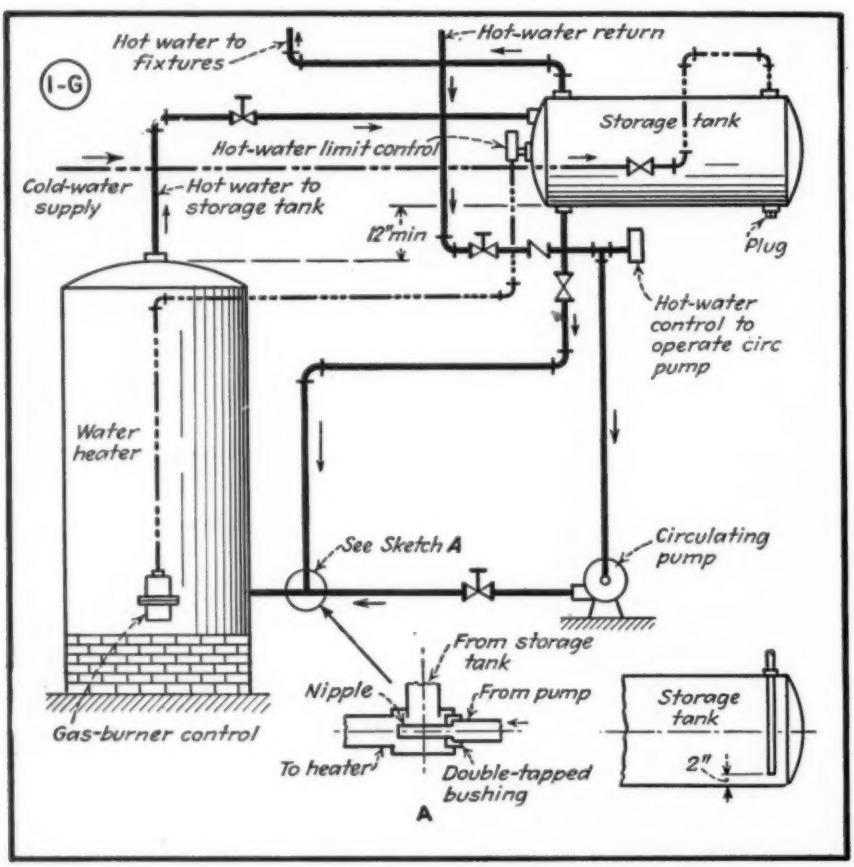
It would be good policy to feed cold water into gas-fired heater rather than storage tank as it is highly probable that feeding cold water into tank lowers the temperature considerably.

Duluth, Minn. E R WEBER

Reconnect Piping With Proper Pitch

SEVERAL FACTORS retard proper operation of *ELB's* system. Check temperature of return line near tank when hot-water demand is maximum. If return pipe is cold under this condition, cold water is passing around the heater direct to outlets. To prevent this, separate the return line from the cold-water supply. Connect return line in a new opening located one third the distance from bottom of tank, 1-*J*.

Inspect hot-water flow line to determine thickness of scale deposit. This may be ¼ in. thick or more, restricting



flow to a point where reversed flow takes place in return line when demand is high. Remember a ¼-in. scale deposit can reduce a line's capacity from 30 to 50%. Remove the scale. Check horizontal hot-water lines' pitch, which should be 1 in. in 10 ft, with tank at low point. This applies to both outgoing and return lines.

Inspect heating surface in gas heater. If water side has a scale deposit ☆ in. thick, clean with dilute hydrochloric acid. Examine fireside of heating surface. If deposits have accumulated, remove with a steel brush or best mechanical means available. Repeat the operation whenever conditions indicate a capacity loss. Adjust gas burner to give hottest flame. Use an orsat to analyze flue gas and make final burner adjustment.

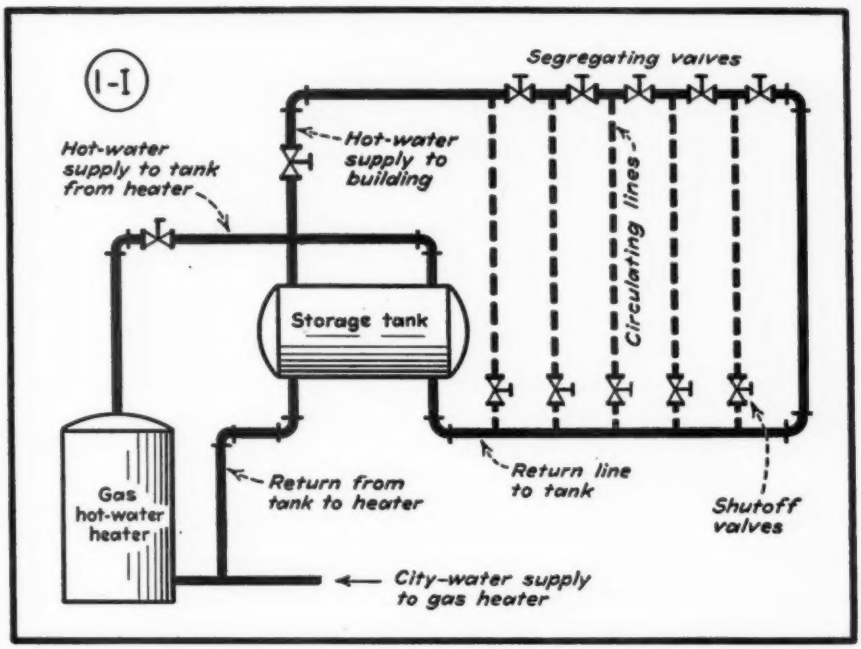
To acquire maximum capacity from gas heater, reconnect to tank as in sketch. Use pipe one size larger and long-radius pipe bends. Connect the outlet to end of tank, 3 to 6 in. below top near hot-water outlet. Connect the inlet to bottom at opposite end. Locate cold-water inlet at bottom on end nearest the heater. If it does not meet demand when so connected and the gas burner is properly adjusted, heater is too small, and should be replaced with a larger unit.

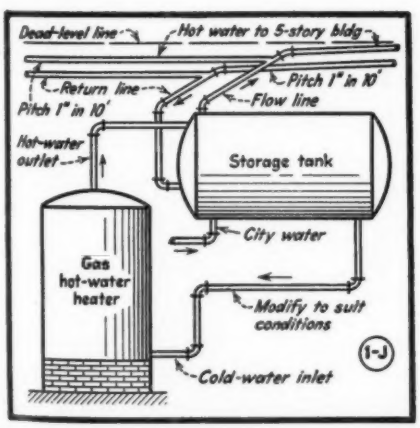
Usually with this layout, no circulating pump is required unless the horizontal hot-water lines are very long. Runs 200 ft long with 20 in. pitch usually give satisfactory circulation.

A circulating pump keeps water moving in the right direction at all times, and forces more water through a given-size line than thermo-siphon circulation. Drawback is cost of pump and its operation. Piping changes should be made first and pump added later if necessary.

Buffalo, N. Y. S C PAGE

(*Continued on page* 152)





How Can I Avoid Spontaneous Combustion?

(This is Question 2 from the August issue, with best answers from readers.)

In the central heating plant of our academy, where we burn lignite coal, we are now planning to enlarge the storage capacity. So far we have had no trouble with spontaneous combustion, but I am wondering if POWER *readers have solved the problem of keeping lignite coal from catching fire while it is in storage.*

Some of the plants near here have experienced this trouble, and it is a lot of hard work removing several carloads of coal and spreading it outdoors to put out the fire.

I would like to know how to handle the coal and how big to make the new bins. If any readers have found that special designs or shapes have been especially successful, will they describe them and also give me some rough sketches or photographs?—LDK

Pile Coal for Field Storage

LDK CAN PRACTICALLY ELIMINATE spontaneous combustion in storing lignite by either of two methods depending on the fuel used: (1) compaction (2) loose piling. First method is used when coal contains a high percentage of fines, such as nut-slack or unprepared stoker coal. Lay out coal in plots 100x50 ft on level ground. A 2-ft layer is spread over entire plot and firmly compacted with a roller or bulldozer. Experiment proves that five 2-ft-deep layers, each firmly compacted, make an ideal pile.

It is important not to allow loose coal to spill over edges of pile as it tends to promote spontaneous combustion. Work can be done by either trucks and rollers or entirely by heavy bulldozer. Exterior of pile slacks somewhat to further air-seal the pile; 700 to 1000 tons is approximate capacity of plot.

Loose-piling method is used for prepared lignite stoker coal that is free of fines. Pile on the plot 100x50 ft is built in one continuous operation to a height of about 8 ft. Piling method depends on equipment at hand. It is most important not to allow coal to be broken down in handling and piling. In a short time exterior surface slacks down to about a 3-in. layer of dust. This air seal prevents interior from slacking. As interior is free of fines spontaneous combustion does not occur. Pile remains in good condition until ready for use. Have hydrant or water line available should local hot-spots occur; little trouble occurs if piling is carried out correctly. If there is more than one pile, allow ample room for a driveway around each pile.

In reclaiming coal take it from one place. Also in heating of a local nature, care should be given in removal of the local spot so as to not affect the pile.

Although these methods do not relate to bin storage, *LDK* may find it impracticable to get enough storage capacity other than in field stockpiling.

Montreal, Que. ARTHUR BELTON

(*Continued on page* 154)

RECIPROCATING-PUMP Q&A FOR POWER ENGINEERS

By E F WRIGHT

2—Water End: Construction and Operation

Second in a monthly series by E F Wright, acting chief engineer, reciprocating pump division, Worthington. This expert on reciprocating pumps has selected questions and answers that give practical understanding of these pumps, their construction, operation, characteristics, troubles and remedies.

Q 1—What is the difference between a piston and a plunger pump?

A—In a piston pump, packing is on the piston inside the fluid cylinder, Fig. 1. Because of packing location, operator cannot see the leakage by it, or make adjustments that might mean the difference between good operation and packing failure. This low-cost construction is satisfactory for low and moderate pressures, but for higher pressures and heavy-duty service the packed-plunger pump is usually favored.

Plunger pumps, Fig. 2 and 3, have stuffing box, packing and gland of same type as those on piston rods of piston pumps. All packing leakage is external where it is a guide in adjustments for minimum leakage compatible with reasonable friction losses and long life of packing and plunger. During operation additional lubrication can be supplied to external packing either through a connection to a stuffing-box lantern ring, or by direct-application to plunger.

Q 2—What is the difference between an outside-packed and an inside-packed plunger pump?

A—Outside-packed plunger pump, Fig. 2, has a separate plunger for each cylinder with each pair of plungers connected by crossheads and side rods external to pump cylinder. Inside- or center-packed plunger pump, Fig. 3, has a single elongated plunger for each pair of fluid chambers, with plunger connected to driving cylinder by a piston rod like that in a piston pump. Stuffing boxes of outside-packed pump, Fig. 2, are more accessible; in larger sizes where plunger weight becomes a problem, external crosshead guides may be used to relieve packing and stuffing box bushings of this weight. A center-packed plunger, Fig. 3, has advantages in a vertical installation where plunger weight does not affect the stuffing boxes and where a stuffing box at cylinder's bottom end may be inaccessible.

Q 3—What is a cap-and-valve-plate direct-acting pump?

A—This valve arrangement on the liquid cylinder, Fig. 1, may be used on either a direct-acting steam pump or a power pump. It is the least expensive and most used cylinder-and-valve arrangement for reciprocating units. Discharge-valve seats, together with valves, valve stems and springs, are mounted in a separate plate, easily removed for servicing or to obtain access to suction valves. In this plate an opening communicates with a cored passage in the cylinder leading to the discharge connection. A dome-shaped cap, subject to discharge pressure, covers the discharge-valve plate.

Suction-valve seats are in the cylinder casting directly below their respective discharge valves. A cored passage leads

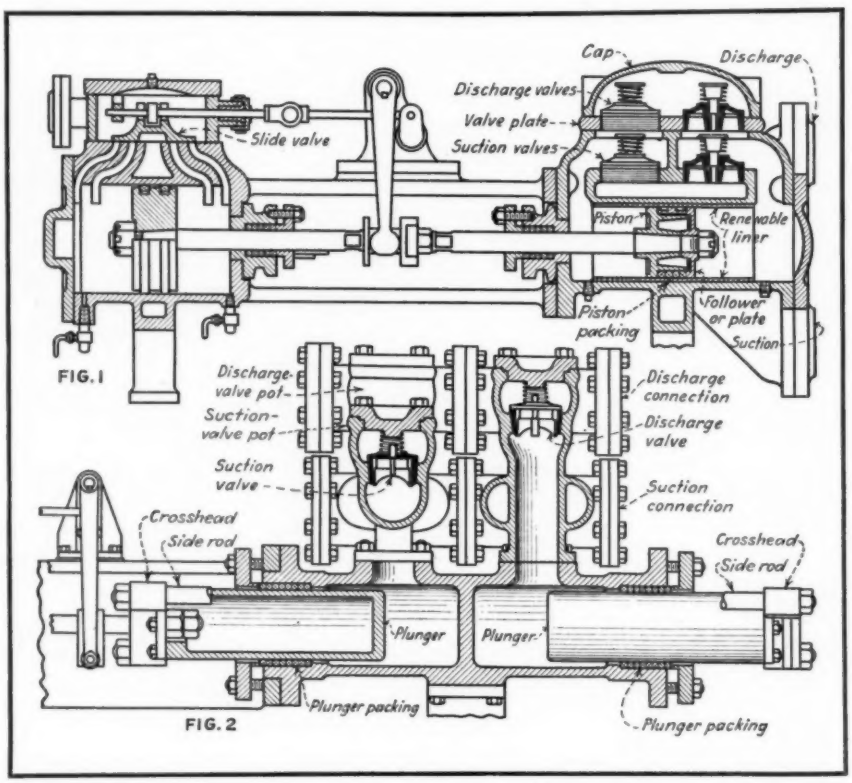


Fig. 1—Cross-section through double-acting duplex cap-and-valve-plate pump. Left: steam piston and "D" slide valve; right: packed fluid piston and valves. Fig. 2—An outside-packed plunger pump has a separate plunger for each cylinder, with each pair of plungers connected by crossheads and external side rods

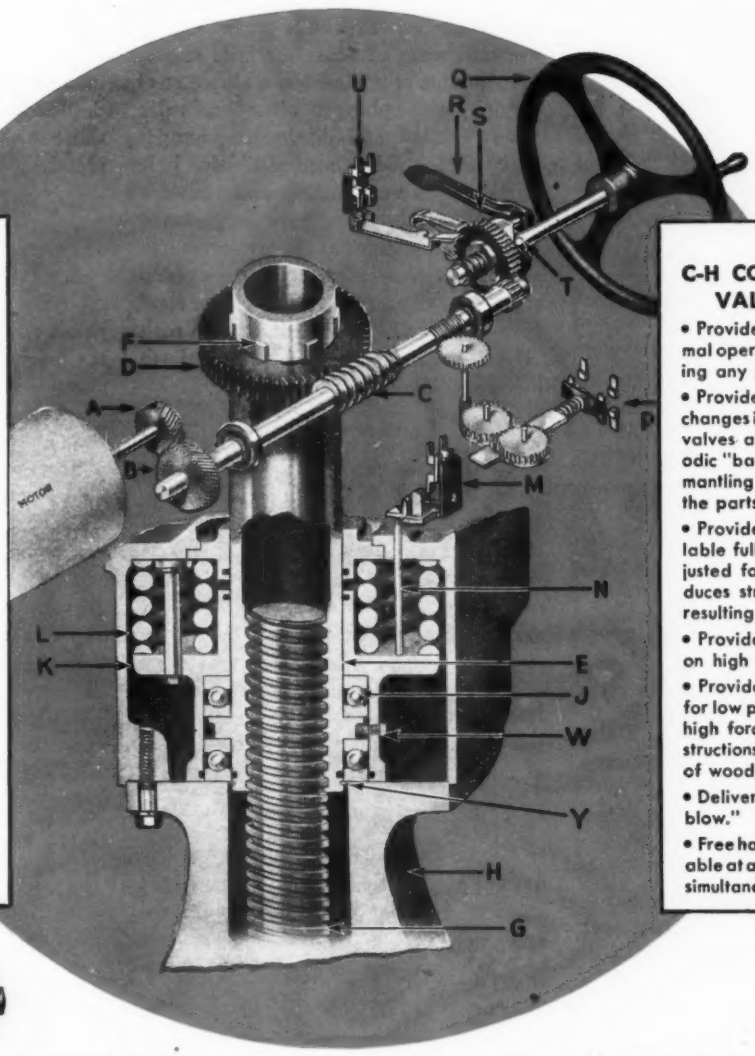
BETTER SEATING ARRANGEMENTS

FOR ALL VALVES

OR...HOW TO GET TIGHT SEATING WITHOUT JAMMING

THE VALVE OPERATOR CONSTRUCTION THAT PREVENTS VALVE JAMMING TROUBLES

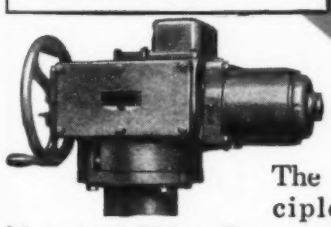
Motor drives yoke nut E thru A, B, C, D and F. When valve disc is seated, yoke nut rises, lifting plate K and rod N, compressing springs L and operating switch M which stops motor. Motor drift, and temperature expansion of stem, are absorbed in springs. Other elements shown are position limit switch and provision for optional hand-wheel operation.



Features of

C-H CONTROLLED THRUST VALVE OPERATORS

- Provides tight closure under normal operating conditions, eliminating any need for "final" seating.
- Provides for large temperature changes in high temperature steam valves and gas valves. No periodic "back off" necessary. No dismantling of valve to "unfreeze" the parts.
- Provides for accurately controllable full power drive, easily adjusted for service conditions. Reduces strain and wear and tear resulting from other systems.
- Provides high speed operation on high pressure valves as well.
- Provides ADEQUATE Protection for low pressure valves... against high forces, against artificial obstructions such as gravel, a piece of wood, etc., in the valve.
- Delivers an unseating "hammer blow."
- Free hand-wheel operation available at any time. Protected against simultaneous electrical operation.



The Controlled Thrust principle of Cutler-Hammer Motorized Valve Operators for all kinds of valves provides the following advantages:

It *always* assures a tightly seated valve regardless of the frictional condition of the valve stem or the driving mechanism.

It *definitely* prevents damage to a valve from the expansion and contraction of valve parts under extremes of temperature.

It *unfailingly* provides correct seating no matter how swiftly the valve is closed.

On water lines, it prevents damage in case foreign matter such as gravel lodges in the valve.

Cutler-Hammer *Controlled Thrust* Valve Operators gain their superiority through what may be called a transferable fulcrum. They drive through a yoke nut fulcrum established by heavy steel springs whose compression is equal to the desired tight seating pressure. When the valve is accurately seated, the *seat* becomes the fulcrum, the yoke nut retracts, opening the motor circuit, and motor drift is absorbed by the springs. Moreover, the same accurate seating is maintained as valve parts expand and contract.

Now is the time to investigate this proven superior motorized valve operator for your plant. Available as standard equipment on all leading makes of valves.... CUTLER-HAMMER, Inc., 1209 St. Paul Ave., Milwaukee 1, Wis.

CUTLER-HAMMER
VALVE CONTROL
C-H

PUMP Q&A

Continued

from below the suction-valve seats, down between the cylinders to suction connection.

Cap-and-valve-plate pumps are usually built for moderate pressures and temperatures, although sometimes they are rated to 350-psi discharge pressure and to 350 F.

Q 4—What is a turret-piston pump?

A—Fig. 4 shows the liquid cylinder of such a pump. It has both suction and discharge valves in the cylinder casting. Access to suction valves is through removable covers on the turret's sides and to discharge valves through the top cover. This cylinder design, for low to medium pressures and relatively large capacities, is adaptable to the use of two or more valves of moderate size in each corner of pump instead of a single large one.

Q 5—What is a plunger-and-ring liquid cylinder?

A—Fire pump, Fig. 5, employs plunger-and-ring construction. Instead of a packed piston this unit has a carefully finished plunger sliding in a closely fitting bronze ring. To reduce weight to a minimum, plunger is hollow, except the center dividing wall, which carries a boss for connection to piston rod. Cylinder is a straight-through pattern with suction valves below and discharge valves above plunger. A large number of moderate-sized valves permit operation at about twice piston speed allowable for continuous-duty pumps.

Plunger-and-ring construction eliminates possibility of piston packing swelling to inoperative tightness or disintegrating during standby periods. Valves of rubber composition have metal backing plates.

Q 6—What is a side pot-valve liquid cylinder?

A—Fig. 6 shows such a cylinder. Suction valves are placed in individual pots on the cylinders' sides and discharge valves in the pots above the cylinders. The relatively small individual valve-pot covers and the valve-and-cylinder arrangement permit design of maximum strength without excessive weight.

Side pot-valve cylinders, in a capacity range from moderate to large, are widely used in refinery and oil-field installations. This design is commonly employed for maximum pressure practicable for a piston-pattern pump.

Q 7—What is a pressure pump?

A—It is primarily a packed-plunger rather than a piston type and is used frequently for hydraulic-press service. For maximum pressure the fluid end of such pumps is made from a single steel forging with plunger chamber, valve holes, suction and discharge passages bored in the solid forging. Valve hole plugs on these pumps often have a metal-to-metal rather than a gasketed joint. For somewhat lower pressures and higher capacities, a pot-valve pump often has cylinders of heavy iron or steel castings. Fig. 2 shows such a pump with valves in individual pots bolted to plunger chamber.

Q 8—What is a tank pump?

A—It is a pump that discharges to a tank. Because of the relatively low discharge pressure required to pump to the elevated tank of an industrial water-supply system the pump's liquid piston is usually as large or larger than the steam piston. A tank pump requires a steam end with maximum cushioning because water in suction and discharge lines tends to keep flowing, thus unloading liquid pistons as they come to rest at the stroke's end.

Q 9—What is a close-clearance pump?

A—A close-clearance fluid end nearly always applies to a simplex pump that handles highly volatile liquids in oil refineries. Fluid valves and passages are arranged for minimum clearance volume and an extended liquid piston overruns the liner at each end of stroke, filling that portion of space between valves, Fig. 8. Under most conditions this pump can compress and discharge vapors that accumulate in the cylinder. Hand-operated priming valves bypass the discharge valves if cylinder becomes vaporbound. Such a liquid-cylinder arrangement has little value on a duplex pump, because of its tendency to short stroke, particularly when not completely primed.

Q 10—What is a differential-piston pump?

A—This design obtains a double-acting pumping effect and loading of the power end with only half the usual number of valves. Piston rod of such a pump is in effect a plunger in that it has one half the area of the liquid piston, Fig. 7. On the piston's forward stroke, suction valve is closed and entire displacement of liquid piston passes through discharge valve. Actual delivery is only half this amount because of flow from above the discharge valve through a passage to piston's plunger on the rod side. On return stroke this fluid is delivered past top of closed discharge valve while cylinder is taking a full charge through the suction valve. Thus the cylinder has a double-acting discharge but only a single-acting suction characteristic.

Q 11—What is a renewable or driven liner in a liquid cylinder?

A—It derives its entire support from the drive in the cylinder bore, Fig. 1 and 4. As a rule such a liner is rela-

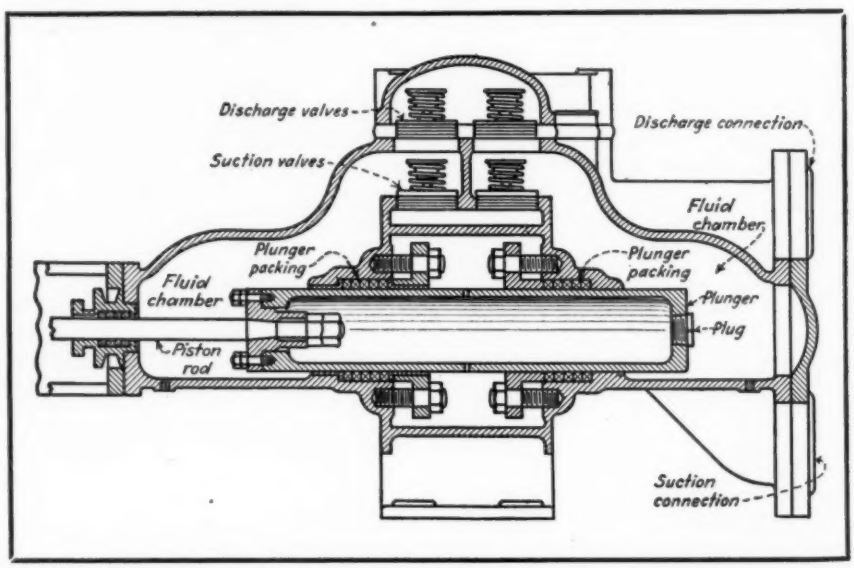


Fig. 3—Center-packed plunger pump has single elongated plunger for each pair of fluid chambers, with plunger connected to driving cylinder by a piston rod

WHY YARWAYS GET EQUIPMENT

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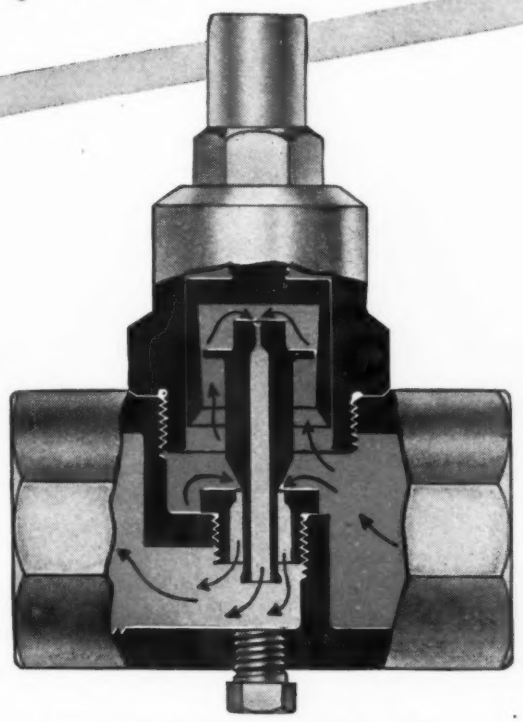
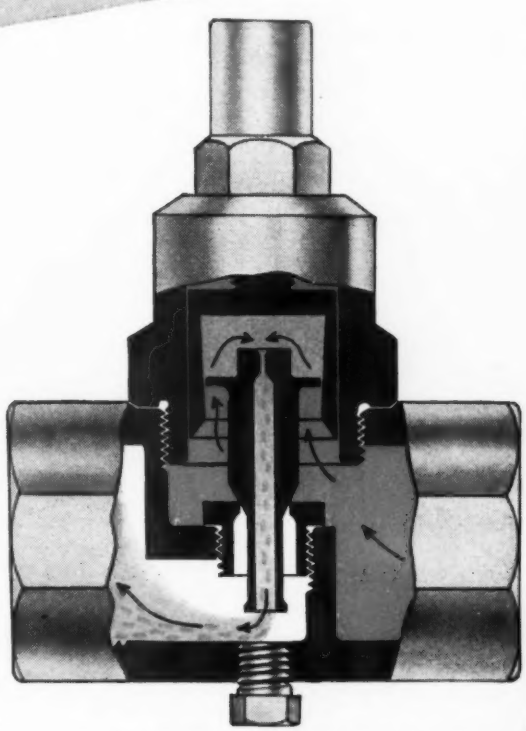


VALVE OPEN—Main flow through seat.



VALVE CLOSED—Main flow shut off.

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PUMP Q&A

Continued

tively thin and commonly made from a centrifugal casting, or a cold-drawn brass tube. After a driven liner is worn to where it must be replaced it is usually removed by chipping a narrow groove its entire length. This groove is cut as nearly as possible through the liner without damage to the wall of the cylinder bore. After chipping such a groove in the liner, it can be easily collapsed inward so that it can be removed readily.

Q 12—What is a removable liner?

A—It may be removed and replaced without damage. Instead of being a driven fit throughout most of its length, it is located longitudinally by flanges at cylinder's ends and is a driven fit only at end of cylinder bore, Fig. 9. For moderate pressures, liner contacts cylinder heads and is sealed by a tight fit at beginning of cylinder bore. For higher pressures a flange fits into a recess at beginning of cylinder bore; this flange is held in contact with a shoulder by jack bolts or a spacer between cylinder head and end of liner. Sometimes a packing ring is used between flange and shoulder for a more positive seal between the two cylinder ends. Removable liners are heavier than renewable ones.

Q 13—What is a wet liner?

A—This special form of removable liner simplifies the cylinder casting in vertical pumps by eliminating the need for a separate passage from cylinder bottom up to valve deck. It fits tightly only at top end just below the flange. Considerable space, between outside of the balance of liner and cylinder barrel,

(*Continued on page* 150)

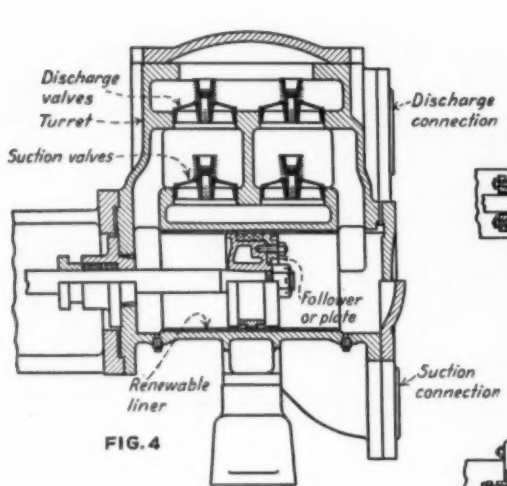
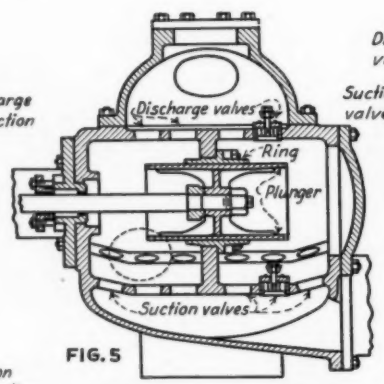


FIG. 4



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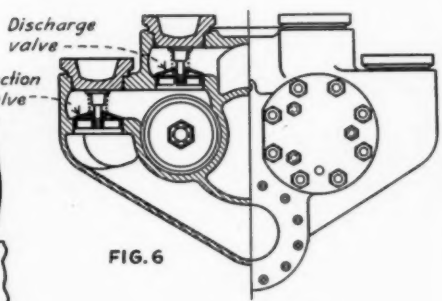

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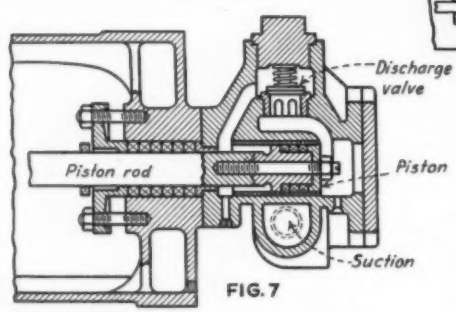


FIG. 7

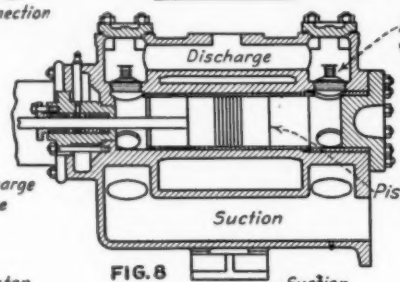


FIG. 8

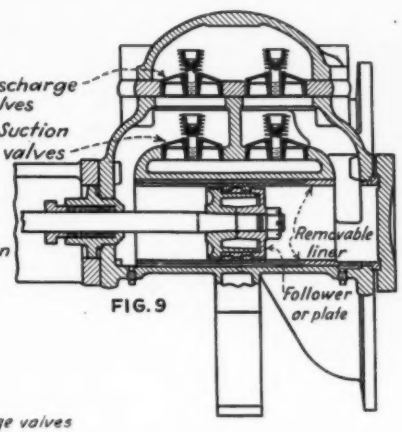


FIG. 9

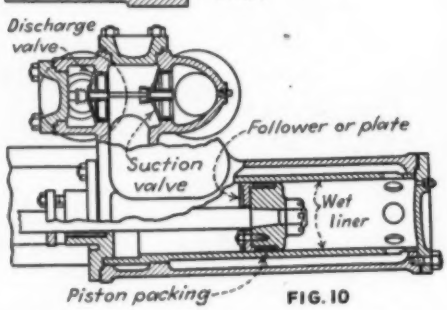


FIG. 10

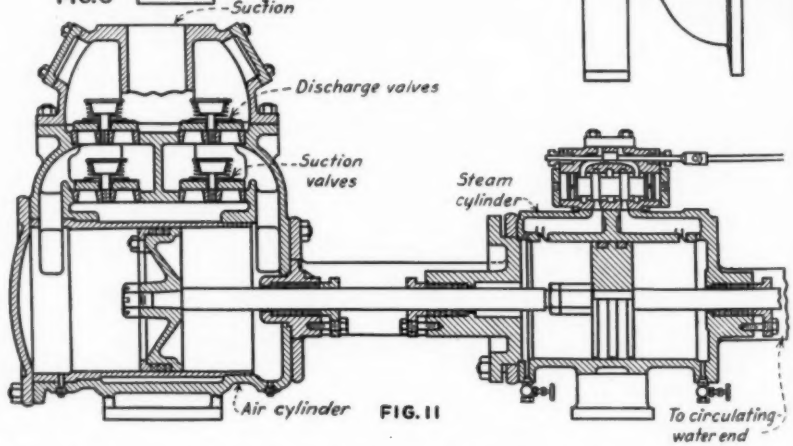
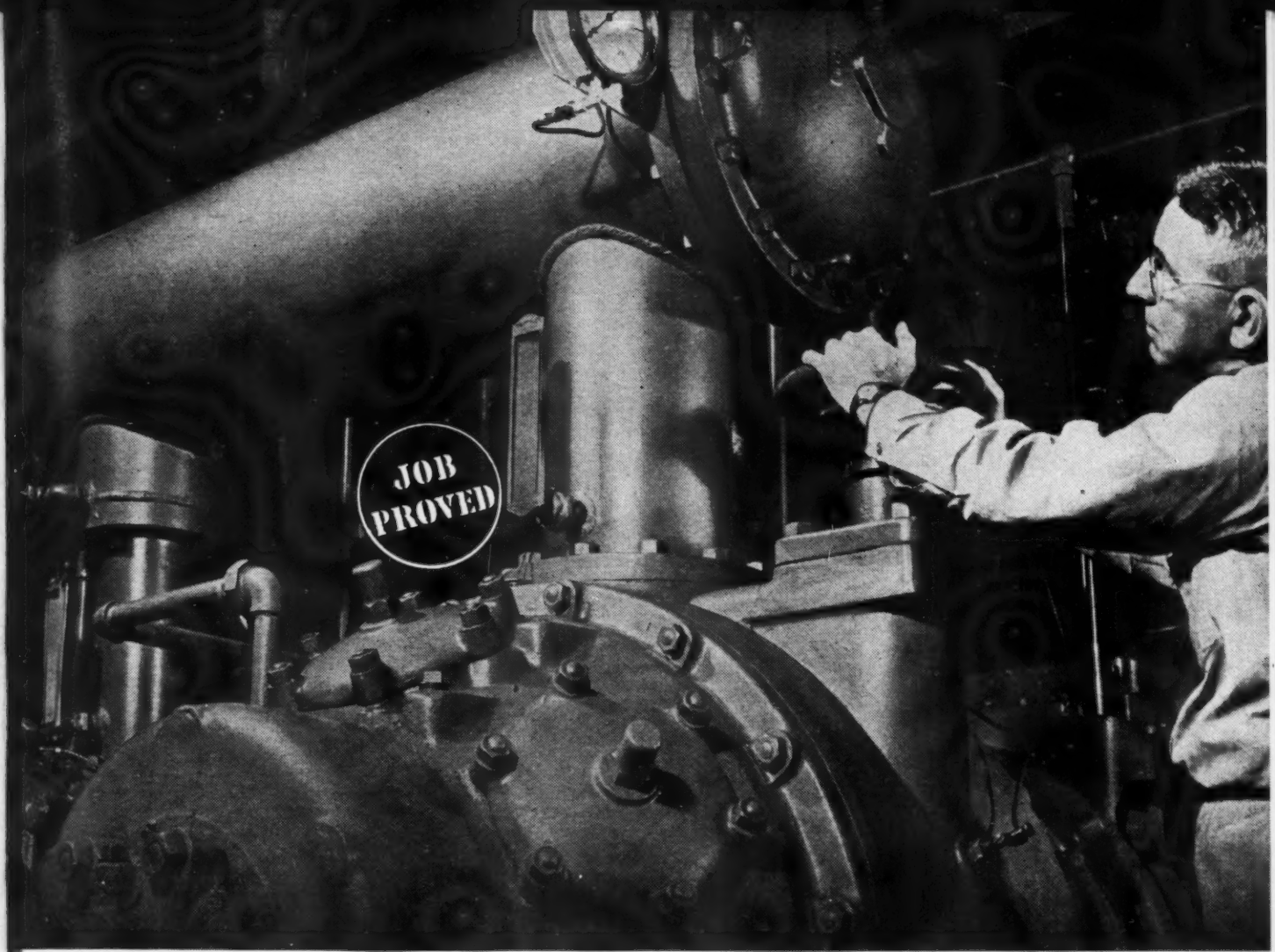


FIG. 11

Fig. 4—In a turret-piston pump, valves are in cylinder casting with access to suction valves through turret's side and to discharge valves through its top. Fig. 5—In plunger-and-ring liquid cylinder, pump has carefully finished plunger sliding in close-fitting bronze ring. Fig. 6—On a side pot-valve liquid cylinder, suction valves are placed in pots on cylinders' sides and discharge valves in pots above cylinders. Fig. 7—Differential-piston pump obtains double-acting effect on discharge with only half the usual number of valves. Fig. 8—Close-clearance pump has piston, valves and fluid passages arranged for minimum clearance. Fig. 9—Removable liner has driven fit at only one end of cylinder casting. Fig. 10—Wet liner has considerable space between it and the cylinder barrel to form a liquid passage from cylinder to valve deck. Fig. 11—A wet-vacuum pump is a special form of submerged piston design to remove the air and water from a steam-condenser hotwell. Suction connection is usually on valve-deck top



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WATER-TREATMENT QUESTION BOX

THE PURPOSE OF A DEAERATOR

By K M Herstein and John S G Shotwell

► THIS FIFTH QUESTION in the water-treatment series discusses deaerators and their action on feedwater.

Goodwater Laboratory
Drum City, U. S. A.
Dear Chemist:

Why is it so important to deaerate boiler feedwater thoroughly? Will you also explain how deaerators work?

Yours truly,
Walter Tender

Dear Walter:

Over 90% of all pitting and corrosion in boilers is caused by oxygen. Chemical reactions, including burning or oxidation, double their rate with every 18-F increase in temperature. As you know, the temperature of boiler water increases as we raise the pressure, so when boiler pressure is increased, the rapidity of corrosion is greatly magnified. Also, as we increase the temperature of water, its ability to dissolve oxygen is lowered, and any oxygen it contains is expelled to attack the boiler metal. A dissolved gas, such as oxygen, does not combine with water chemically, but rather is dissolved in it in the same way as salt or sugar.

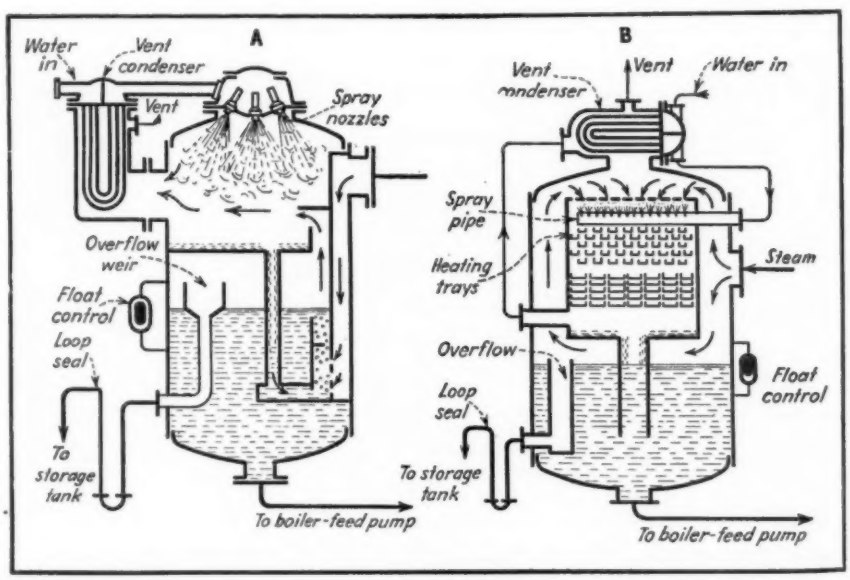
As mentioned previously (POWER, March 1946), cold water dissolves more oxygen than hot. This is easily demonstrated by allowing a glass of ordinary cold tap water to stand in a warm room. Within a short time, the inside of the glass is covered with bubbles of gas. If the water is boiled, most of the dissolved gas is driven off. If the water is then exposed to a vacuum, or sprayed into one, more oxygen is removed. Tests show that oxygen content falls to about 0.5 cc per liter if the water, at a temperature above that corresponding to the vacuum, is sprayed into a vacuum, regardless of the initial oxygen content. Entering this low-pressure area the entrained gas comes out of solution.

Remaining oxygen, experience indicates, is too high for boiler water if corrosion is to be held in reasonable check. While the original oxygen release comes from rapid formation of bubbles, the final traces must be removed by a diffusion process, which takes time and requires exposure of thin sheets or atomized drops. The process is exactly the opposite of the absorption of oxygen from the surrounding atmosphere into a lake or reservoir.

These last traces of oxygen may be removed either by chemical means, such as the use of some reducing agent (a chemical that is extremely hungry for and combines readily with oxygen) or by sweeping the surface of the hot water with a gas that absorbs oxygen. In deaeration this is done by using trays or sprays to give the water a large surface, and by maintaining a continuous flow of water vapor across this surface. In this way the oxygen content can be reduced to less than 0.005 cc per liter, or less than 1/800 cu in. per gal. It is important not to allow the deaerated water to contact open air between the deaerator and boiler drum. The deaerator itself consists of two parts: (1) heating and deaerating section (2) tank for storing heated and nearly oxygen-free condensate until it is needed.

Not only does water in river, lake or pond pick up oxygen, but it also gets into feedwater if water in the hotwell of the condenser is not kept sufficiently heated. Exposed storage and surge tanks, and the glands of suction pumps are other sources of contamination. In all these sources, other deleterious gases, such as CO_2 and ammonia, may cause additional trouble by being drawn into the condensate and the feedwater. With proper deaeration, the danger of corrosion in boilers is greatly reduced because mechanical apparatus that takes out oxygen also reduces CO_2 as well.

Yours truly,
Chemist
Goodwater Laboratory



(A) Spray-type deaerator uses a steam scrubber for secondary oxygen removal. (B) Tray-type unit uses heating and air-separating trays in the center chamber

PIPING FLEXIBILITY *with* Edward *Check Valves*

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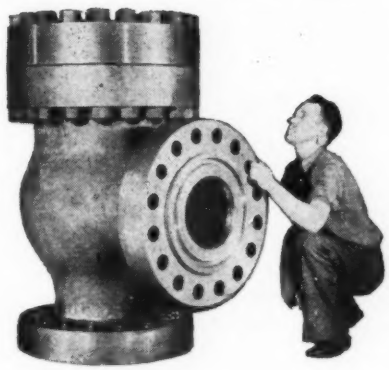
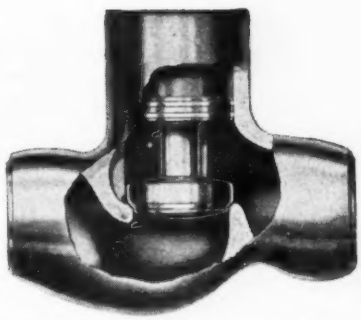
BIG CHECKS

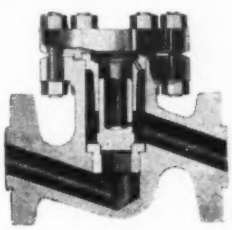


Vibration, clatter and damaging shock to piping are eliminated with Edward piston-type check valves. Integral guide ribs, cored out for free flow, guide the hourglass disk-piston throughout travel to prevent hanging up. New flow contours reduce pressure loss, increase operating efficiency. Built in sizes through 14 in.

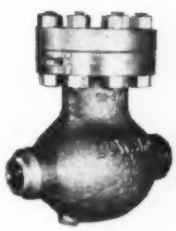


AVAILABLE IN HORIZONTAL ~ . . . ANGLE ⌐ . . . VERTICAL |

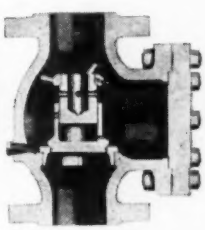
MEDIUM



Exclusive Edward disk guide lip aids tight seating and cuts wear on seat and disk through momentary throttling action.



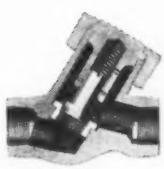
Edward check valves may be disassembled without removing from the line. Covers are forged steel.



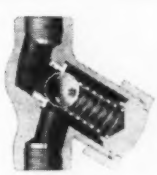
AVAILABLE IN HORIZONTAL ~ . . . ANGLE ⌐ . . . VERTICAL |

SMALL

Edward forged steel check valves are spring loaded to insure quick, accurate seating. Bodies are streamlined.



For viscous fluids or hydraulic service, Edward ball checks are ideal. Stainless steel ball is mated to seat.



Design of small Edward checks permits use in either horizontal or vertical lines. Built in sizes down to ¼ in.

AVAILABLE IN HORIZONTAL ~ . . . ANGLE ⌐ . . . VERTICAL |

A request on your company letterhead will bring you an Edward Catalog.

ROCKWELL E V

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO EAST CHICAGO, INDIANA

MATH TIPS

JOHN KING GIVES HELPFUL HINTS TO EVERYDAY USERS OF NUMBERS AND HOMESPUN MATHEMATICS

17-SLIDE RULE: Squares and Cubes, Part 3

▶ BY FAR THE COMMONEST POWERS and roots in everyday engineering are squares and cubes. To take care of them the Mannheim slide rule added these two special scales: (1) *A* scale for squares and square roots, Fig. 1, and (2) *K* scale for cubes and cube roots, Fig. 2. Both scales work with *D* scale.

We learned in "Logs for Powers and Roots" (p 122, July 1946): To raise a number to a power, multiply its log by the power; to extract a root, divide the log by the root. *A* and *K* scales are derived by applying this principle to *D* scale. Since distances represent logs on the slide rule, *A* scale is *D* scale multiplied by 2, and *K* scale is *D* scale multiplied by 3.

SQUARES AND SQUARE ROOT

To square any number, move indicator to the number on *D* scale; read the square under hairline of indicator on *A* scale, above. Square of 2 is 4, of 6 is 36, and of 15 is 225. Locate decimal point as in multiplication.

Square root is the reverse process; that is, locate the number on *A* scale and read the square root directly below on *D* scale. There is only one hitch in this process—where do we locate the number on *A* scale? There are two sections and each has the number. When *D* scale represents numbers between 1 and 10, *A* scale represents numbers 1 to 100, or square of numbers included by *D* scale since $1^2 = 1$ and $10^2 = 100$. Left half of *A* scale represents numbers 1 to 10, and right half 10 to 100. From this relation it is easy to find square root of numbers between 1 and 100. Fig. 1 shows several square roots correctly indicated.

A simple method for extracting square roots reduces all numbers to values between 1 and 100. For numbers greater than 100, start at the decimal point and draw a horizontal bar over the digits in groups of two until only one or two digits remain. Place a temporary decimal point here (indicated by a small *x* in examples below). New number is always less than 100. Take square root of this number, as described, and move decimal point one place to right for each horizontal bar.

Problem: $\sqrt{25675} = ?$ Draw horizontal bar over numbers thus, $2x\overline{56}\ \overline{75}$. Move decimal to new location indicated by cross; extract square root of 2.56, $\sqrt{2.56} = 1.60$. Move decimal point 2 places to right, one for each horizontal bar; then $\sqrt{25675} = 160$.

For numbers less than 1, start at decimal point and place horizontal bar over zeros in groups of two until first digit other than zero is included under a bar. Place temporary decimal point on right side of last bar.

Problem: $\sqrt{0.000413} = ?$ Move decimal point to right: $\overline{0.00}\ \overline{04}x13$, $\sqrt{4.13} = 2.03$. Move decimal point back 2 places to left, indicated by two horizontal bars; then $\sqrt{0.000413} = 0.0203$.

This process divides or multiplies the number by 100, a perfect square, enough times to reduce results to a number less than 100. Results are multiplied or divided by as many 10's as 100's previously used to reduce the number. Square root of 100 is 10.

CUBES AND CUBE ROOT

To cube any number locate the number on *D* scale and read its cube directly below on *K* scale. Locate the decimal point as in multiplication.

Cube root is the reverse of cubes: Locate the number for which the cube root is desired on *K* scale and read the answer on *D* scale directly above. Again we want to know where to locate the number since *K* scale has 3 sections. As in square root, when *D* scale is 1 to 10, *K* scale is 1 to 1000 because $1^3 = 1$, and $10^3 = 1000$. Left section of *K* scale represents numbers 1 to 10, middle section 10 to 100, and right section 100 to 1000.

Reduce the number as in square root but this time to a value below 1000 by drawing horizontal bars across three digits at a time.

Problem: $\sqrt[3]{47485} = ?$ Draw horizontal bar over $\overline{485}$; this leaves $\overline{47}x\ \overline{485}$, $\sqrt[3]{47.48} = 3.62$. Move decimal 1 place to right for 1 horizontal mark; then $\sqrt[3]{47{,}485} = 36.2$

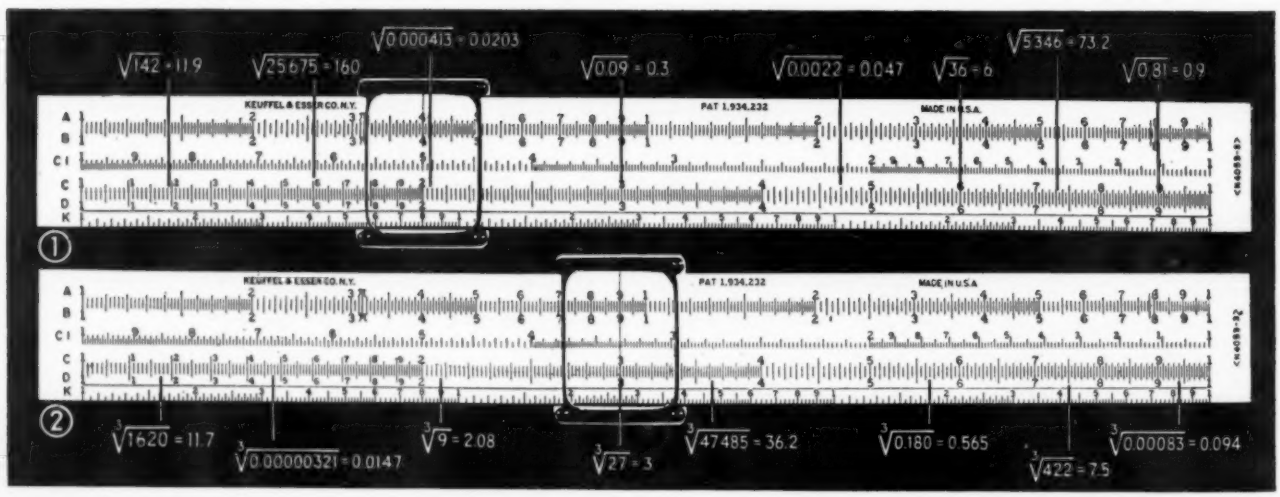
Problem: $\sqrt[3]{0.00000321} = ?$ Move decimal point to right: $\overline{.000}\ \overline{003}x21$; extract cube root of 3.21; $\sqrt[3]{3.21} = 1.47$. Move decimal point two places to left; then $\sqrt[3]{0.00000321} = 0.01475$.

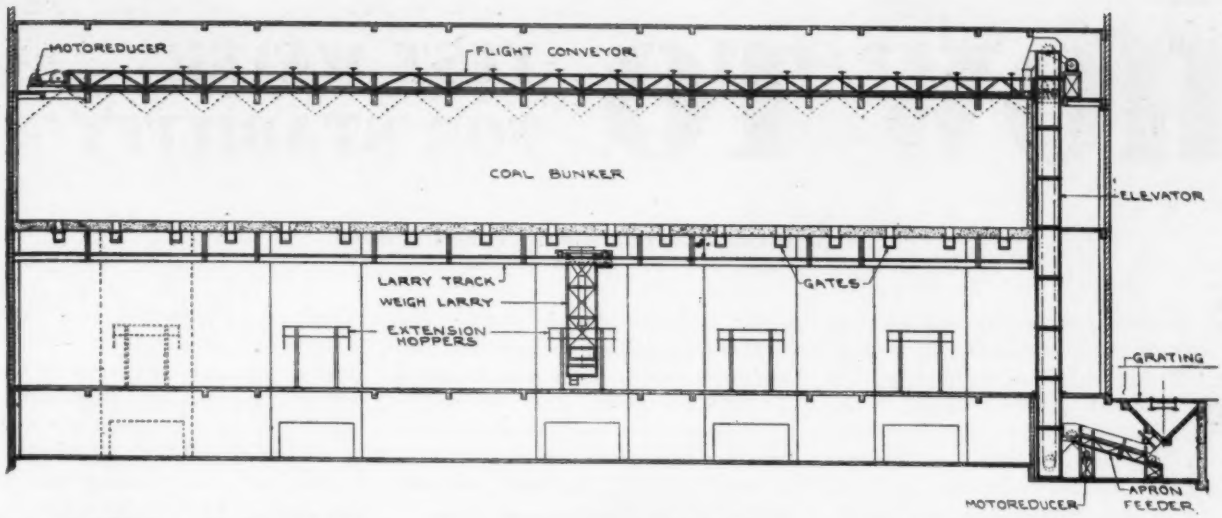
Check the cube roots, correctly shown in Fig. 2, on your slide rule.

Next month, special use of slide rule.

* Slide Rule, courtesy Keuffel & Esser Co., N. Y.

Fig. 1 (top)—On the slide rule,* square root, A scale is on D scale. Fig. 2 (bottom)—Cube root, K scale is on D scale





Line drawing showing general arrangement of the equipment.

100 TONS or 10 TONS PER HOUR CAPACITY

FAIRFIELD

COAL HANDLING SYSTEMS WILL MEET YOUR NEEDS

• Whatever your requirements may be, Fairfield will design—build—and erect the complete coal handling system to meet your specific condition.

To illustrate—the system shown handles coal automatically from car to concrete bunker to weigh larry to stokers at the rate of 100 tons per hour. In this instance a continuous type elevator deposits coal on flight conveyor which distributes it the full length of the bunker. The motor operated weigh larry feeds coal to stokers as required.

This illustrates but one of many methods of coal handling designed and built by Fairfield which are operating today efficiently—economically—meeting the needs of the individual plant.

Consult a Fairfield Engineer on your coal and ash handling requirements.

View of weigh larry feeding stoker extension hoppers.

THE FAIRFIELD ENGINEERING CO.

Builders of Coal and Ash Handling Equipment

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HOW TO TEST WATER FOR STABILITY

By C A NOLL, *Chief Chemist, W H and L D BETZ*

▶ PREVENTING SCALE AND CORROSION is a major item of maintenance on a water system supplying process and cooling requirements. In the prevention of heavy scale deposits, surface-active materials (phosphates, tannins, lignins, starches) broaden or increase the solubility of scale-forming salts and permit an oversaturated quantity to be present without precipitation. On the other hand, if scale is totally absent, oxygen and carbon dioxide dissolved in the water attack the metal readily.

One way to protect a once-through system against corrosion is to maintain the water slightly oversaturated with respect to calcium carbonate, which permits deposition of a thin protective film over the metal surfaces. Materials commonly added to neutralize the free acidity or carbon dioxide and increase the alkalinity and pH are soda ash, lime and caustic soda. Lime also increases the calcium content.

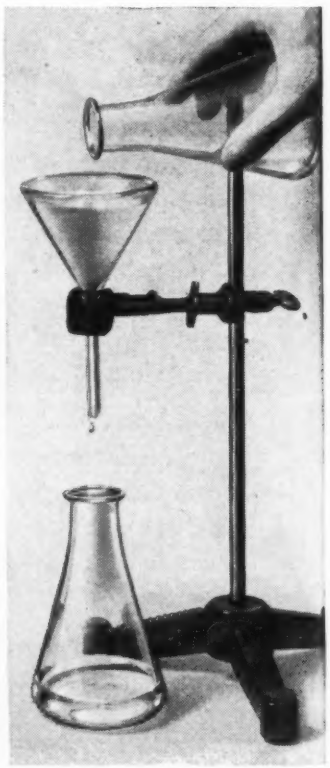
To assure the deposition of a film at the point of lowest temperature it is necessary to have the water oversaturated at this temperature, which means that a thicker film will deposit in regions of higher temperature. Where the difference between maximum and minimum temperature is great, surface-active treatment must be introduced to control scale formation in the above-normal-temperature apparatus.

The test outlined below indicates whether the water has a tendency to form scale at test temperature, but not the quantity of scale that forms. For example, if the water has a low calcium content but a high alkalinity and pH, indications are that scale will result. However, because the water is low in calcium, the calcium carbonate that does deposit is not sufficient to coat the entire metal surface. Therefore dissolved gas is free to attack bare areas and produce localized corrosion.

When calcium content is low, feed lime to oversaturate the water as dictated by the test, or add a metal-coating material such as phosphates or silicates. Both the phosphate and silica treatments require an appreciable time to form the protective film; sometimes as much as 90 days. To hasten initial film formation higher concentrations may be introduced, after which the dosage is reduced to an amount sufficient to maintain the thin protective film.

1 First step is to determine alkalinity to methyl orange or similar indicator, POWER, April 1940. Take a 50-cc sample, add 4 drops of methyl orange and titrate with N/50 sulphuric acid until color changes to orange.

2 Take an equal quantity of the water to be tested and add a slight excess of certified-pure precipitated calcium carbonate. Stir the mixture a few minutes, and let flask stand until the suspended particles settle.



3 Filter the sample and test it for alkalinity. If second alkalinity is greater than first, water is undersaturated. If first is greater, water is oversaturated and may deposit scale. If both are the same, water is stable.

Hardly any job is Too BIG or Too SMALL for ANACONDA COPPER TUBES

MOST PIPELINES for the conveyance of lubricants, refrigerants, gases, low pressure steam, compressed air, water, or other fluids will run between 1/8" and 12" in diameter.

This is the regular range of seamless Anaconda Copper Tubes. Special size seamless tubes under 1/8" and from 12" through 26" are also furnished.

Though the material cost of such tubes may be higher than that of rustable pipe, *installed cost* is often lower. In addition, copper tubes provide these service features:

Their smooth, non-rust, corrosion-resistant interior reduces the possibility of built-up deposits. Downtime for cleaning and repairs is reduced to a minimum. And because of their high corrosion-resistance, copper tubes offer durability and long life.

Detailed information? Write for Publication C-24, "Anaconda Copper Tubes for Industrial Applications."

4009

2500' reel of seamless copper capillary tubing. .075" O. D. x .025" I. D., in single unjointed length.

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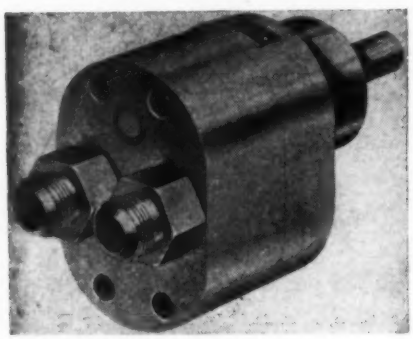
WHAT'S New IN PLANT EQUIPMENT

Diaphragm-Regulating Valve

DIAPHRAGM HEAD is of all-steel construction. Casing is boltless, being assembled with quick-acting clamp rings. Diaphragm is made of molded reinforced Neoprene. Position indicators are standard equipment. Bodies are of bronze, semisteel, cast steel or special alloys with a wide variety of trim materials. Inner valves are quick opening, V-port or parabolic with the disks guided at top and bottom. **Dept P, Kieley & Mueller, Inc, 2013 43rd St, North Bergen, New Jersey.**

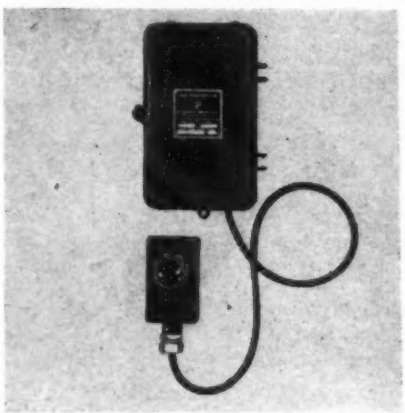
Diesel-Engine Arc-Welder

A DIESEL-ENGINE-DRIVEN 300-amp arc-welder is for application where electric power is not available. The 47-hp 1450-rpm engine has two 4½x5-in. cylinders, oil cooling, displacement blower and fuel-filtering equipment. Welder is equipped with multi-range remote control, which permits operator to make volt-ampere adjustments right at the work. Generator uses separate exciter on main shaft. Governor controls engine speed, and special idling device automatically idles the unit when welding is not in progress. Welder can be mounted on a trailer or truck for easy portability. **Dept P, Hobart Brothers Co, Hobart Square, Troy, Ohio.**



High-Pressure Pump

SERIES 700 IS DESIGNED for high-pressure application for materials-handling equipment, road-making machinery, machine tools, oil-well sampling, power transmission and proportioning duty. Manufacturer states that the 6-lb unit has a volumetric efficiency in excess of 90%, and mechanical efficiency above 80%. Capacity ranges from 0.4 to 9.6 gpm against pressures up to 1000 psi. **Dept P, McIntyre Co, 15 Riverdale Ave, Newton, Mass.**



Photoelectric Controller

MANUFACTURER recommends Series 20 and 21 controllers for such applications as counting, conveyer control, short-range signal systems, motor or valve control, production inspection, machinery safeguards, and stop-motion control in textile, paper and wire industries. Phototube, which must be located at point of control, is available (1) integral with the housing or (2) in a separate small case. **Dept P, Photoswitch Inc, 77 Broadway, Cambridge 42, Mass.**

Air Diffuser

AGITAIR RS-42 is for applications requiring a combination supply- and return-air feature. Air diffuser comes in either square or rectangular shape and permits both ducts to run on same plane with separate connections for supply and return air. It comes in a variety of sizes and patterns with complete diffusion control. **Dept P, Air Devices, Inc, 17 E 42nd St, New York 17, N. Y.**

Steam Cleaning Machine

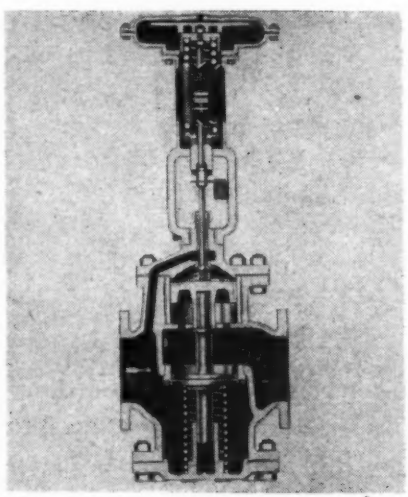
STEEL-FABRICATED, electric-welded steam cleaning machine mounts on semisteel wheels. *JO Hypressure Jenny* employs either oil- or gas-firing. Only requirements, besides operating fuel, are (1) outlet from an electric-lighting circuit and (2) hose connection to a water supply.

A highly atomized mixture of steam, hot water and cleaning compound discharges through a spray nozzle under pressure ranging from 80 to 120 psi. Normal output runs 90 gal of water per hr; *Adjusta-Blast* gun (optional equipment) steps this output up to 480 gal of water per hr. Over-all dimensions are 55x28x47½ in. Machine weighs 520 lb. **Dept P, Homestead Valve Mfg Co, Coraopolis, Pa.**

Masonry Drill

CEMENTED-CARBIDE cutting tip enables *Kennadrill* to take hold readily in drilling of hard, brittle materials and glazed surfaces, thus removing the need for any starting punch. Tip extends beyond drill-shank diameter so that generous annular space gives freedom from binding.

This reputedly strong, long-lasting drill operates in any rotary drill at normal speeds for such equipment. The ¼-, 5/16-, ⅜- and ½-in. sizes are available for ¼-in. capacity drills and ½-, ⅝-, ¾-, ⅞- and 1-in. sizes for 1¼-in. capacity drills. **Dept P, Kennametal Inc, Latrobe, Pa.**



Balanced Single-Seat Valve

FULLY BALANCED diaphragm-operated regulating valves, with cast-iron, bronze and steel bodies, are for steam, air or gas pressures up to 1000 psi. Valves are actuated by standard pressure or temperature controllers using 20-psi air or water as operating fluid. The valve trim of 800 Brinell hardness is standard equipment. Valves seat tight on head-end service. They are designated as classes D-1 (cast iron or bronze) and DS-1 (steel). **Dept P, Leslie Co, 255 Grant Ave, Lyndhurst, New Jersey.**

(*Continued on page* 132)

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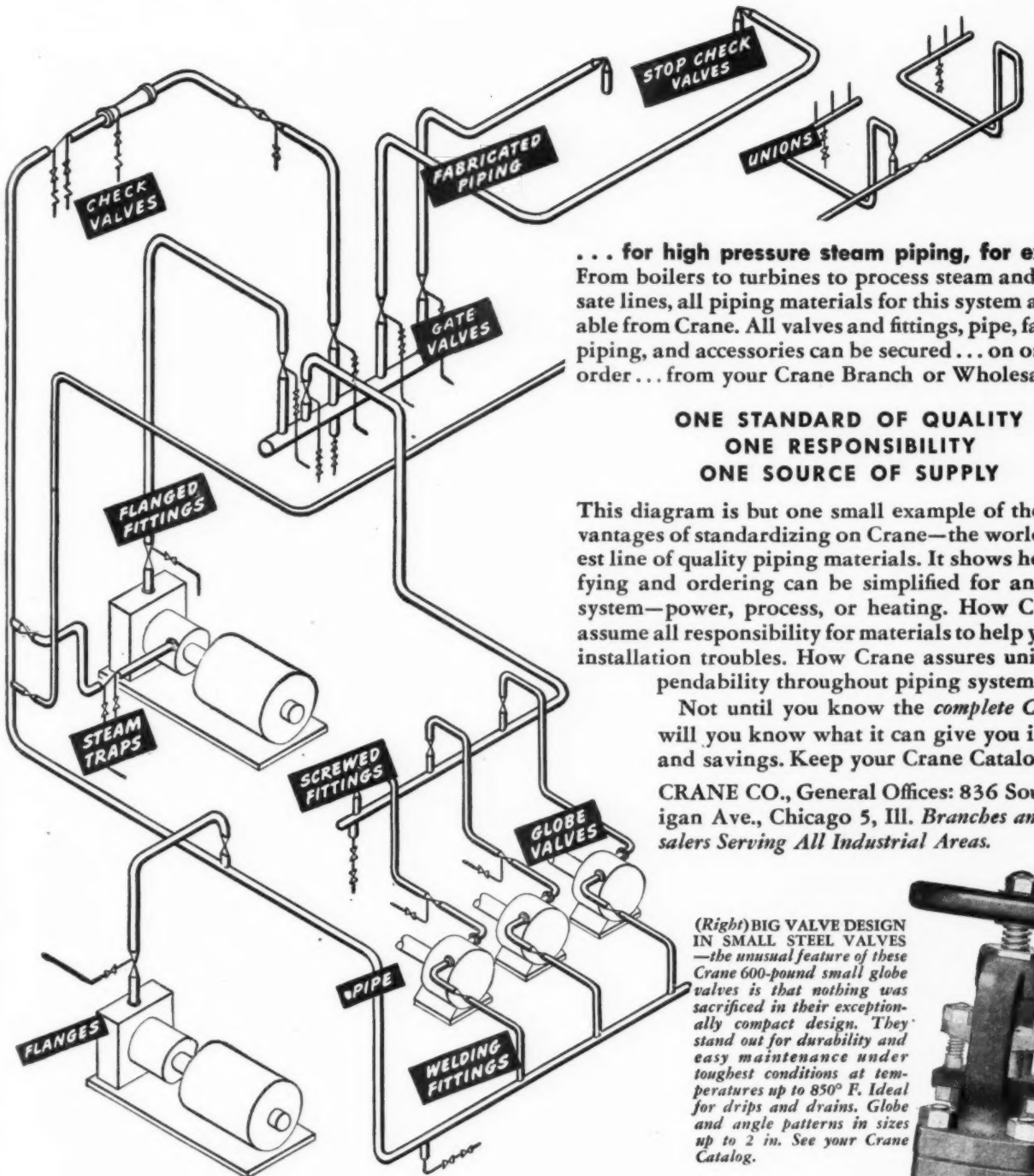
ONE ORDER TO CRANE...

Covers All Piping Materials



. . . for high pressure steam piping, for example. From boilers to turbines to process steam and condensate lines, all piping materials for this system are available from Crane. All valves and fittings, pipe, fabricated piping, and accessories can be secured . . . on one single order . . . from your Crane Branch or Wholesaler.

ONE STANDARD OF QUALITY
ONE RESPONSIBILITY
ONE SOURCE OF SUPPLY

This diagram is but one small example of the big advantages of standardizing on Crane—the world's greatest line of quality piping materials. It shows how specifying and ordering can be simplified for any piping system—power, process, or heating. How Crane can assume all responsibility for materials to help you avoid installation troubles. How Crane assures uniform dependability throughout piping systems.

Not until you know the *complete Crane line* will you know what it can give you in service and savings. Keep your Crane Catalog handy.

CRANE CO., General Offices: 836 South Michigan Ave., Chicago 5, Ill. *Branches and Wholesalers Serving All Industrial Areas.*

(*Right*) BIG VALVE DESIGN IN SMALL STEEL VALVES —*the unusual feature of these Crane 600-pound small globe valves is that nothing was sacrificed in their exceptionally compact design. They stand out for durability and easy maintenance under toughest conditions at temperatures up to 850° F. Ideal for drips and drains. Globe and angle patterns in sizes up to 2 in. See your Crane Catalog.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
HEATING • PUMPS

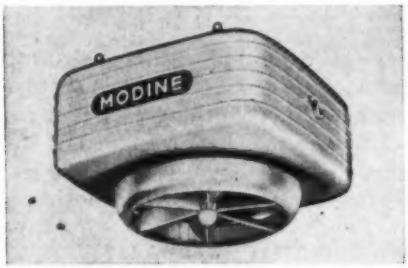
CRANE

FOR EVERY PIPING SYSTEM

EQUIPMENT *Continued*

Feedwater-Test Kit

BOILER FEEDWATER can be tested for hardness, alkalinity and chloride content with this test kit, which contains necessary solutions and precision-made pipette droppers for accurate measurement. Test kit comes in white portable cabinet, 10x10x4¾ in. Kit can be modified to permit testing for sodium sulphite. **Dept P, Permutit Co, 330 W 42nd St, New York 18, New York.**



Unit Heater

NEW PROPELLER unit heater harmonizes with modern industrial and commercial interiors. All models are finished in attractive beige-gray enamel with chrome trim. Casings are acoustically insulated for quiet operation and *Parker-Bonderized* for rust protection before painting. Copper fins are mechanically and metallically bonded to the tubes, which are brazed into pressure-resisting units. **Dept P, Modine Mfg Co, Racine, Wis.**

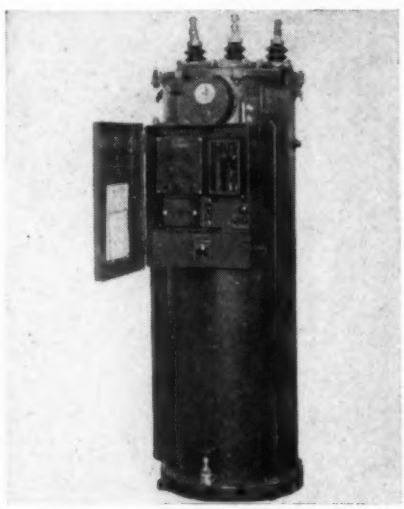
Control Instrument

MODEL 40 CONTROLLER regulates temperature, pressure, flow and other variables in continuous processes. Adjustment dials are accessible when case door is open. Easy replacement or interchange of unit parts makes servicing in the field easy. Settings are easily changed and an adjusting device permits zeroing pen without realigning control point. Transfer switch enables operator to change from manual to automatic control. It is made as an indicator as well as a single-pen and multi-pen recorder for on-off control action—proportional, proportional and reset, proportional with derivative, and proportional and reset with derivative. **Dept P, Foxboro Co, Foxboro, Mass.**

Silver-Brazing Alloys

EASY-FLO 45 AND EASY-FLO 35 feature low silver content. *Easy-Flo* 45 is a 45% silver alloy. It also contains copper, zinc and cadmium. One of its exceptional features is a new low-melting range—1120 to 1145 F. Joints produced between ferrous, nonferrous and dissimilar metals are strong, ductile, leak-tight.

The 35% alloy has characteristics quite different from *Easy-Flo* 45. It has wider melting range—1115 to 1295 F—and is free flowing at an exceptionally low temperature for an alloy containing 35% silver. It offers an opportunity to produce joints economically between ferrous or non-ferrous metals which are high in strength and ductility. **Dept P, Handy & Harman, 82 Fulton St, New York 7, N. Y.**



Induction-Voltage Regulator

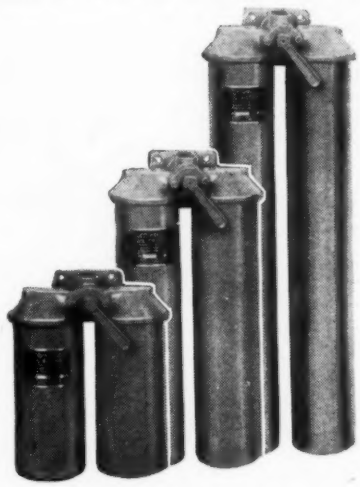
NEW DOUBLE worm gear eliminates rotor creeping from magnetic force within and gives quiet operation. A dish-shaped spring, between ends of worm and positive stops on shaft, gives axial motion to worm. As worm moves freely on shaft it is cushioned by springs, and thus prevents gear noise.

A synthetic-rubber seal eliminates breathers and provides sealed-tank construction. The cork gasket, formerly under pressed-steel cover, is replaced by synthetic rubber, which forms a weatherproof and pressure-tight joint. **Dept P, General Electric Co, Schenectady.**

Fuel-Oil Filter

DUPLEX FUEL-OIL FILTER provides an uninterrupted fuel-oil flow to engine. Valve control directs oil flow from one side of filter to the other simply by turning handle. Units are available in sizes for engines ranging from 200 to 10,000 hp. They mount directly on engine with a bracket.

Made-up throw-away cartridges with gaskets attached permit quick easy charging and avoid loose parts. Specially processed cellulose filtering material avoids channeling by careful packing of material of uniform density. Metal covering on filter keeps contents from migrating.

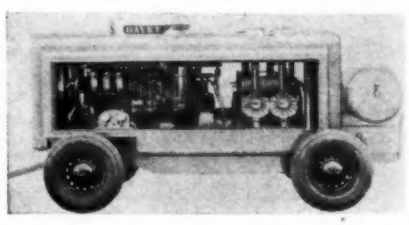


Filter works equally well on light or heavy fuel oil. **Dept P, Hilliard Corp, 120 W 4th St, Elmira, N. Y.**

Portable Air Compressor

KNOWN AS both 315-W (gas) and 315-WD (diesel), this 100-psi 315-cfm compressor is available in standard skid, steel-wheel or pneumatic-tire trailer style and flanged-wheel designs for railroad work. It comes with either gas- or diesel-engine drive. Electric starters are standard on diesel units and each compressor cylinder has its own air filter. **Dept P, Davey Compressor Co, Kent, Ohio.**

(*Continued on page* 134)



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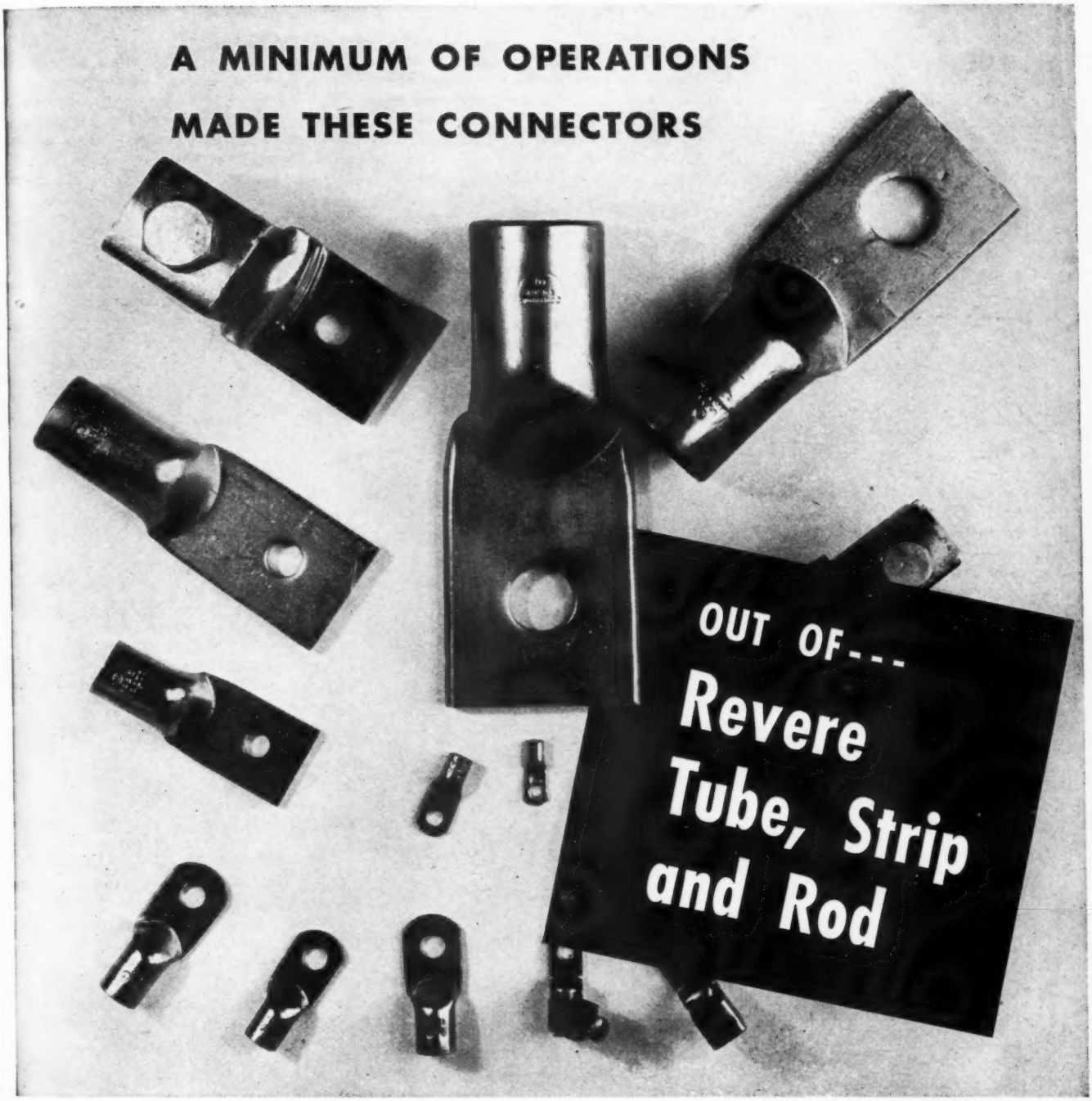

THESE electrical connectors are but a few out of the hundreds of types being made today out of Revere copper and copper alloy tube, strip and rod.

Soldering lugs are made of Revere seamless tube, and are finished by simple stamping and punching. Solderless connectors are manufactured of tube, strip, bar and rod. The easy workability of the metal, plus the fact that it is supplied in forms requiring a minimum of operations, make Revere a favorite source of supply.

Other Revere products for electrical purposes include: Electrolytic and silver bearing copper commutator bar and segments; O.F.H.C., silver bearing, and electrolytic copper for armatures and rotors of micromotors and fractional h-p motors; Specially Prepared Switch Copper for switches, bus bars and similar applications; Extruded copper shapes for contacts, contact arms, solderless connectors, etc.; Free Cutting Rod for parts machined to close tolerances; Tubular rivet wire.

The Revere Technical Advisory Service will gladly work with you in studying your requirements and determining the Revere mill products that lend themselves to the most economical manufacture and best service.

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Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere

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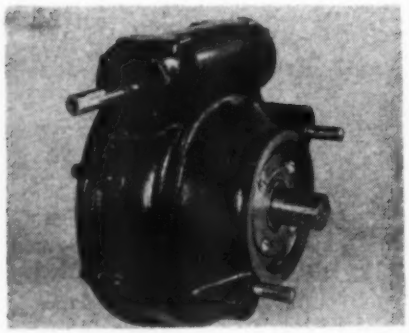
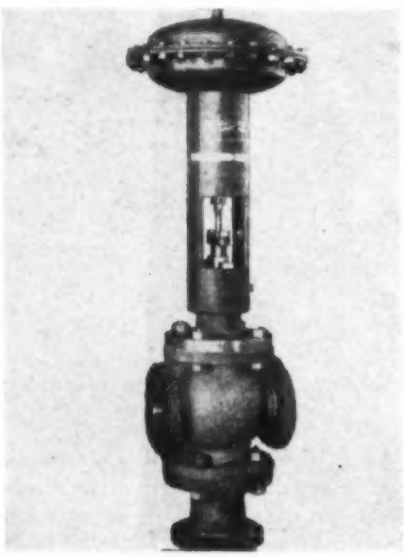


Stoker Drive

A GEAR-AND-PINION combination coupled with a 4-to-1 V-belt drive gives, its manufacturer claims, a universal stoker drive that handles stokers ranging from small household size to industrial units. Line of models will include three sizes, 15 to 50, 75 to 250, and 250 to 1200 lb of coal per hr. At present only smallest is in production.

A single *Cone-Drive* gear-and-pinion, together with a 4-1 V-belt, reduces speed from 1750 rpm at motor shaft to 2.2 rpm at gear shaft and stoker feed screw. Adopting small gear teeth reduces load on individual teeth by spreading total load over 14 of them, and to the entire depth and most of the width of each loaded tooth. **Dept P, Stoker Drive Co, Frederick, Md.**

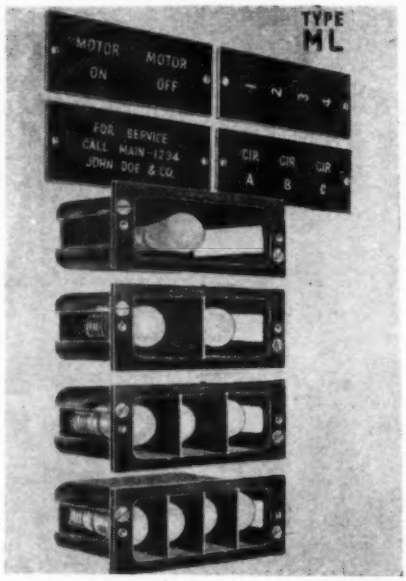


Automatic Valve

UNITS ARE AVAILABLE in cast iron, steel, bronze or cast stainless steel, in sizes from ¼ to 6 in. Neoprene diaphragm positions valve plug to regulate flow between the two outlet ports from zero to 100%. This 3-way valve carries a position indicator, stuffing-box lubricator and bolted stuffing-box gland. **Dept P, Hammel-Dahl Co, 243 Richmond St, Providence 3, Rhode Island.**

Template Follower

AIR-COUPLED, hydraulic template follower has no limitation in power amplification, states its manufacturer. *Follow-Up Unit*, in its standard design, is reputed accurate to 0.002 in. at a speed up to 20 in. per min when following template cut from light-gage stock. **Dept P, Askania Regulator Co, 1603 S Michigan Ave, Chicago, Ill.**



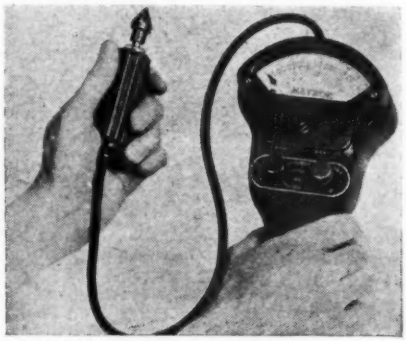
Indicating Lights

BAKELITE LAMPHOLDER housing comes in sizes for one to four S6-120-v bulbs (¾ in. OD) or smaller-diameter bulbs. *ML* unit face plate resembles black-faced plates with white, engraved markings, but inner core is translucent. When lamp bulb lights engraved marking brightens, making plate both a nameplate and an indicating light. **Dept P, H R Kirkland Co, Morristown, N. J.**

Plastic Insulator

TOUGH, DURABLE, unaffected by temperature and humidity are the claims for a plastic material advocated as an electric insulator for handles and grips of pliers, wrenches, wire cutters, as well as cable ends, busbars and connectors.

Plastic comes in cap and sleeve form and is applied for diameters up to one in., and for any length. Immersion in a special dilator solution causes plastic to expand 50% over its normal diameter. In this state it can be stretched and applied to diameters of over one in. On drying, the plastic shrinks, giving a tight fit. **Dept P, Chemical Dept, General Electric Co, Pittsfield, Mass.**



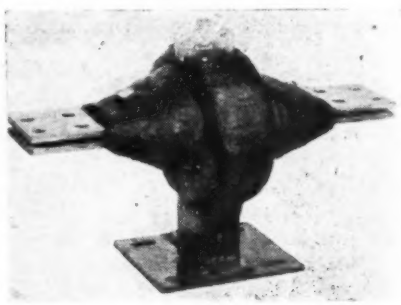
Hand Tachometer

STYLE 25B MEASURES rotating speeds down to 10 rpm and linear speeds as low as 1 fpm. Upper ranges are 10 to 200, 20 to 400, and 50 to 1000 rpm. Low- and high-speed adapters extend its range down to 1 rpm and up to 10,000 rpm. Speed range can be changed while tachometer head is engaged without damage to instrument. Manufacturer claims accuracy is 1% of full-scale reading. **Dept P, Metron Instrument Co., 432 Lincoln St, Denver 9, Colo.**

Current Transformers

TWO NEW CURRENT TRANSFORMERS are for meter, relay and control-device applications. *JKL*-3 is rated 5000 v, 1200 to 4000 amp, and withstands full-wave impulse tests at 60 kv in accordance with ASA standards. *JKL*-4 is rated 8700 v, 1200 to 4000 amp, and withstands full-wave impulse tests at 75 kv. Both the *JKL*-3 for 2400- and 4800-v lines and the *JKL*-4 for 7200-v lines have been designed for accurate metering over normal current range up to 100% of rating and also for relay operation up to 20 times rated current. **Dept P, General Electric Co, Schenectady 5, N. Y.**

(*Continued on page* 142)



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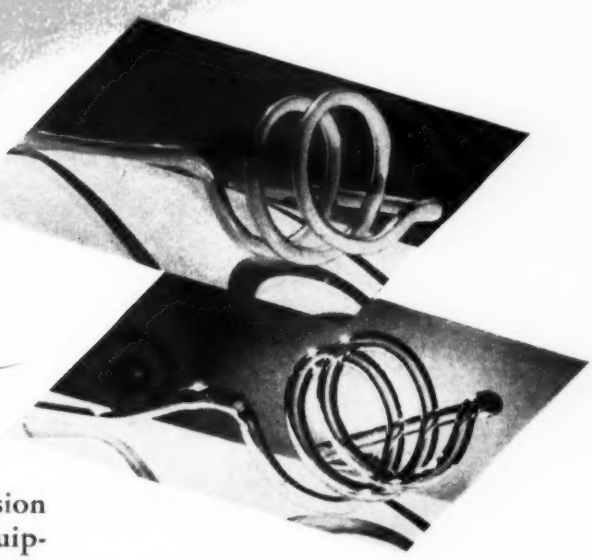
HERE IS A *positive* METHOD OF WATER STABILIZATION

says: Eugene Dieker

NALCO REPRESENTATIVE, KANSAS CITY, MISSOURI



• *Nalco Laboratory experimental coil at top shows the scaling effect of untreated hot water passing through feed lines.*

• *Coil at bottom is still sparkling clean after handling the same amount of the same water under the same conditions, but following Nalco individualized stabilization treatment.*

Stabilizing water to prevent scaling and corrosion in water lines, heat exchangers and process equipment is a Nalco specialty... And endless Nalco research and experimentation have uncovered only one positive method of stabilization: Plant surveys to determine operating and water conditions, followed by Nalco Laboratory recommendations for specific water treatment to meet the exact needs of the individual plant.

A new Nalco Stabilization Bulletin gives full information on the factors contributing to unstable water... tells how the Nalco System can operate in your plant to provide positive stabilization. Write for your copy today.

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Canadian inquiries should be addressed to Aluminate Chemicals, Ltd., 555 Eastern Avenue, Toronto, Ontario.

nalco

NALCO—The Scientific System of Water Treatment for All Industry

How to plan a

WELL WATER COOLING WATER SYSTEM

Another in the series of basic Piping Layouts prepared by Jenkins Bros.

Water cooling at a lower cost than with cooling towers can often be accomplished with well water, which is available in adequate supply throughout large areas of the nation. The diagram shows a practical system which takes advantage of the relatively constant well water temperature of 50° to 60° in all seasons.

Heat exchangers are frequently used, because of the clogging, scale-forming or corrosive action of many well waters. This confines the flow of cooling water to the tubes, which can be readily cleaned or replaced. Sand filters are included to prevent the carry-over of sand into the equipment. They are installed in duplicate to permit uninterrupted operation while renewing the filter material. The large quantities of water handled often preclude the use of the city sewer system and the water must be disposed of by returning it to the ground through diffusing wells.

Since underground water must be kept suitable for drinking purposes, in certain areas the use of a heat exchanger and the return of the water to the ground uncontaminated is mandatory. Such requirements are met by this layout.

Because many well waters rapidly attack some copper base alloys when associated with ferrous metals, all-bronze valves or alternate all-iron valves are listed. Iron body bronze mounted valves are not recommended for this purpose. With the exception of Fig. 47 and Fig. 40-A, the gates and globes recommended are outside screw and yoke type to keep threads free from sand and to provide extra strength for operating if valve becomes partially clogged with sand. These valves have bolted bonnets which permit easy access

Jenkins PRACTICAL PIPING LAYOUTS

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

A Use the right type valve for the service.
B Place valves correctly in the line.
C Choose Jenkins Valves for lifetime economy.

15

Fig. 677A (flanged) All-Bronze Gate Valve
125 lbs. Steam
200 lbs. O.W.G.

for cleaning – particularly essential for those located at the base of system where sand collects.

Other types and pressure ranges of Jenkins Valves can be used for this type of layout, according to the factors involved. Consultation with accredited piping engineers and contractors is recommended when adapting these suggestions to your own requirements, or when planning any major piping installation.

Copies of Layout No. 15 will be furnished on request . . . also copies of future Piping Layouts. Just fill out and mail the coupon.

Fig. 677A, a Jenkins All-Bronze Gate Valve (flanged) is especially recommended for use in industrial plants and in connection with water-treatment apparatus where iron valves would create corrosion problems. It permits full, free, unobstructed flow, and, where service conditions require frequent cleaning and lubrication of spindle threads, these O.S.&Y. valves are particularly desirable. Its exceptional wear-resisting qualities are typical of Jenkins *extra value.*

A CHOICE OF OVER 600 JENKINS VALVES

To save time, to simplify planning, to get the advantage of Jenkins specialized valve-engineering experience, – select all the valves you need from the Jenkins line, fully described in the Jenkins Catalog No. 76. It's your best assurance of *the lowest cost in the long run.*

Jenkins Bros., 80 White Street, New York 13; Bridgeport; Atlanta; Boston; Philadelphia; San Francisco; Chicago; Jenkins Bros., Ltd., Montreal; London, England.

JENKINS VALVES

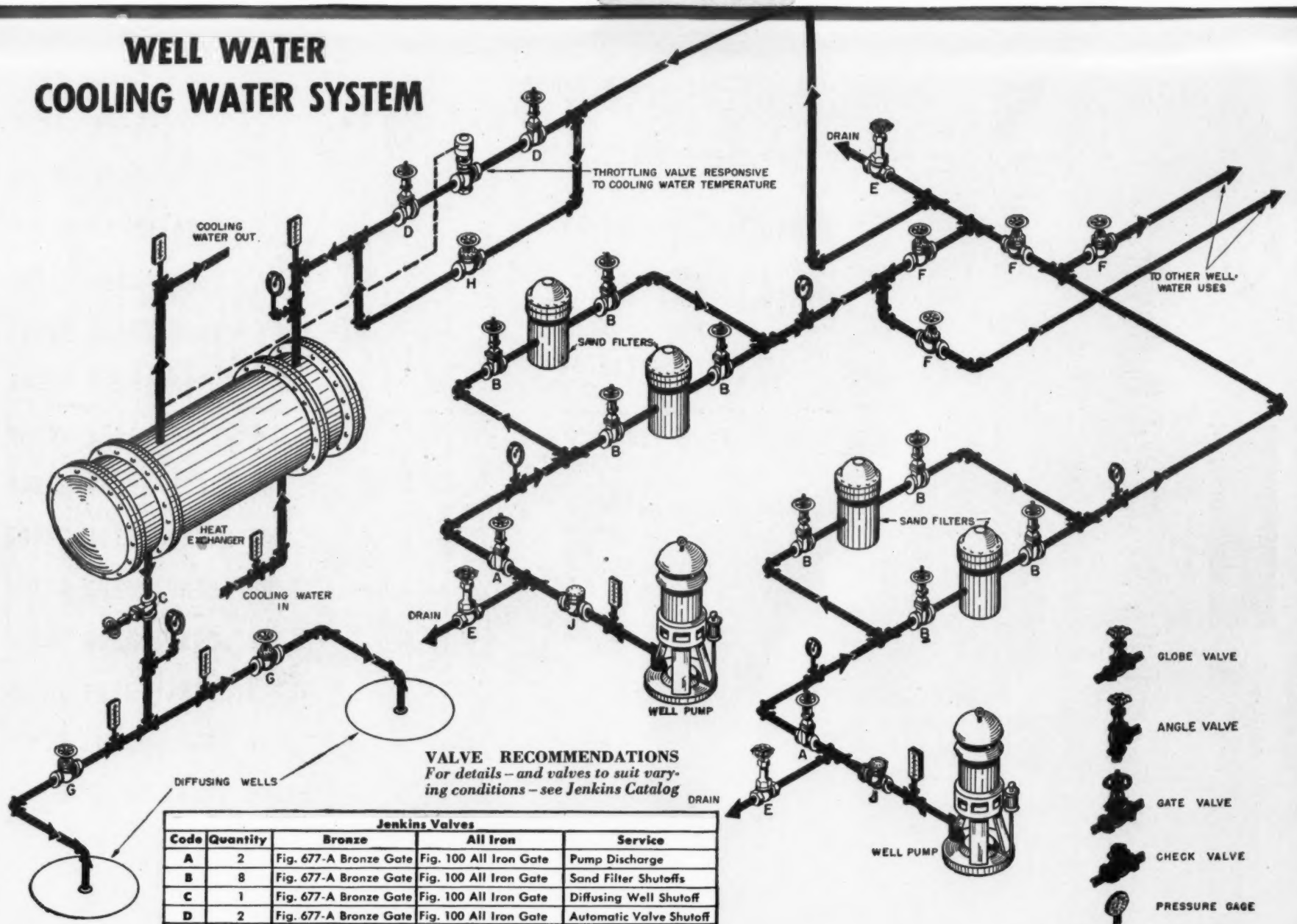
LOOK FOR THE DIAMOND MARK
SINCE 1864

TRADE JENKINS MARK

125 TO 600 LBS. STEAM PRESSURE

Jenkins Bros

WELL WATER COOLING WATER SYSTEM



VALVE RECOMMENDATIONS

For details – and valves to suit varying conditions – see Jenkins Catalog

Jenkins Valves				
Code	Quantity	Bronze	All Iron	Service
A	2	Fig. 677-A Bronze Gate	Fig. 100 All Iron Gate	Pump Discharge
B	8	Fig. 677-A Bronze Gate	Fig. 100 All Iron Gate	Sand Filter Shutoffs
C	1	Fig. 677-A Bronze Gate	Fig. 100 All Iron Gate	Diffusing Well Shutoff
D	2	Fig. 677-A Bronze Gate	Fig. 100 All Iron Gate	Automatic Valve Shutoff
E	3	Fig. 47 Bronze Gate	Fig. 40-A All Iron U-Bolt Gate	Drains
F	4	Fig. 661 Bronze Globe	Fig. 142 All Iron Globe	Well Water Header Valves
G	2	Fig. 661 Bronze Globe	Fig. 142 All Iron Globe	Diffusing Well Control
H	1	Fig. 661 Bronze Globe	Fig. 142 All Iron Globe	Manual Bypass about Automatic Valve
J	2	Fig. 295 Bronze Swing Check	Fig. 295 All Iron Swing Check	Pump Discharge Check

Diagram by Huxley Madeheim, Consulting Engineer

BRONZE ★ IRON ★ STEEL

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JENKINS BROS., 80 White St., New York 13, N. Y.

Please send me a reprint of Piping Layout No. 15 and future Layouts as they become available.

Name .....

Company .....

Address .....

Number 170

Speeds With Standard Pulleys: I

SPEEDS WITH 1750-RPM MOTORS: *Driver- and Driven-Pulley Diameters in Inches*

PULLEYS, DIA

DRIVER, IN.	3	3½	4	4½	5	5½	6	7	8	9	10	11	12
DRIVEN, IN.	Speed of driven shaft, rpm												
3	1750												
3½	1500	1750											
4	1312	1530	1750										
4½	1166	1360	1555	1750									
5	1050	1225	1400	1575	1750								
5½	955	1114	1273	1432	1590	1750							
6	875	1020	1166	1313	1458	1604	1750						
7	750	875	1000	1125	1250	1375	1500	1750					
8	656	766	875	984	1093	1203	1312	1531	1750				
9	583	680	778	875	972	1069	1166	1361	1555	1750			
10	525	613	700	788	875	963	1050	1225	1400	1575	1750		
11	477	557	636	716	795	875	955	1113	1273	1432	1591	1750	
12	438	510	583	656	729	802	875	1020	1167	1313	1458	1605	1750
13	404	471	538	606	673	740	808	942	1077	1212	1346	1481	1611
14	375	438	500	563	625	688	750	875	1000	1125	1250	1375	1500
15	350	408	467	525	583	642	700	817	933	1050	1168	1282	1398
16	328	383	438	492	547	602	656	766	875	984	1094	1203	1310
18	292	340	389	438	486	535	583	681	778	875	972	1070	1167
20		306	350	394	438	481	525	613	700	788	875	963	1048
22		278	318	358	398	438	477	557	636	716	795	875	953
24			292	328	365	401	438	510	583	656	729	802	875
26				303	337	370	404	471	538	606	673	740	806
28				281	313	344	375	438	500	563	625	688	750
30					292	321	350	408	467	525	583	642	700
36						267	292	340	389	438	486	535	583
42								292	333	375	417	458	500
48									292	328	365	401	437
54										292	324	356	389
60											292	321	350
66												292	318
72													292

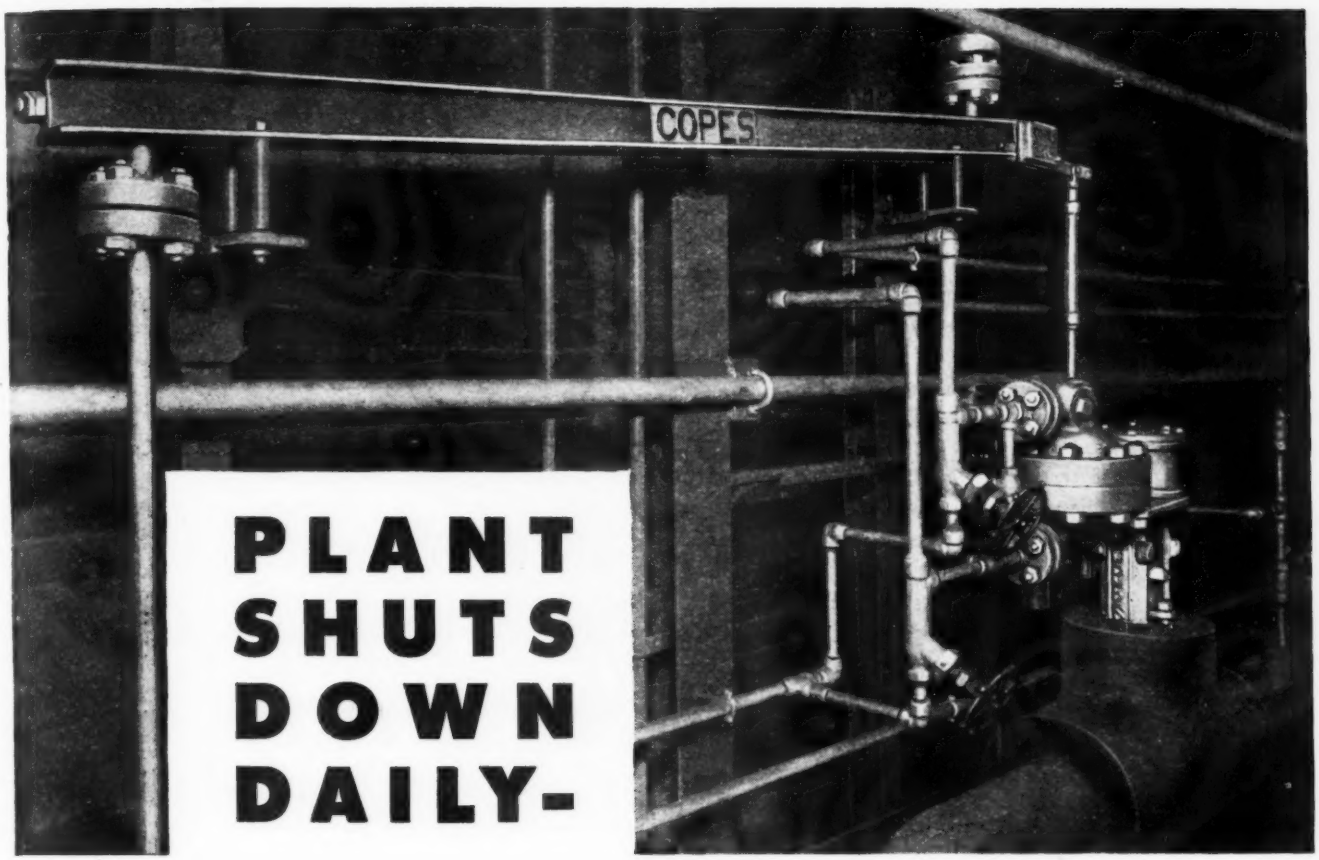
SPEEDS WITH 1150-RPM MOTORS: *Driver- and Driven-Pulley Diameters in Inches*

PULLEYS, DIA:

DRIVER, IN.	3	3½	4	4½	5	5½	6	7	8	9	10	11	12	13	14	15	16
DRIVEN, IN.	Speed of driven shaft, rpm																
3	1150																
3½	986	1150															
4	863	1005	1150														
4½	767	894	1022	1150													
5	690	805	920	1035	1150												
5½	627	732	836	941	1046	1150											
6	575	671	767	863	958	1054	1150										
7	493	575	657	739	821	904	986	1150									
8	431	503	575	647	719	791	863	1006	1150								
9	383	447	511	575	640	703	767	894	1022	1150							
10	345	403	460	518	575	633	690	805	920	1035	1150						
11	314	366	418	470	523	575	627	732	836	941	1045	1150					
12	288	335	383	431	479	527	575	671	767	863	958	1054	1150				
13	265	310	354	398	442	487	531	619	708	796	885	973	1062	1150			
14	246	288	329	370	411	452	493	575	657	740	821	904	986	1068	1150		
15	230	268	307	345	383	422	460	537	613	690	767	843	920	997	1073	1150	
16	216	252	288	323	360	395	431	503	575	647	719	791	863	934	1006	1078	1150
18	192	224	256	288	320	351	383	447	511	575	639	703	767	831	894	958	1022
20		201	230	259	288	316	345	403	460	518	575	633	690	748	805	863	920
22		183	209	235	261	288	314	366	418	470	523	575	627	680	732	784	836
24			192	214	240	264	288	335	383	431	479	527	575	623	671	719	767
26				199	221	243	265	310	354	398	442	487	531	575	619	663	708
28				185	205	226	246	288	329	370	411	452	493	534	575	616	657
30					192	211	230	268	307	345	383	422	460	498	537	575	613
36						176	192	224	256	288	319	351	383	415	447	479	511
42							164	192	219	246	274	301	329	356	383	411	438
48									192	216	240	264	288	311	335	359	383
54										192	213	234	256	277	298	319	341
60											192	211	230	249	268	288	307
66												192	210	227	244	262	278
72													192	208	224	240	256
78														192	207	221	236
84															192	205	219
90																192	204
96																	192

Example: To find the speed of a driven shaft with a 22-in. pulley belted to an 8-in. pulley on the shaft of a 1750-rpm motor (1) locate the 8-in. column in the 1750-rpm table and (2) find the intersection with the 22-in. line, which reads 636 rpm

Courtesy of American Leather Belting Association's Engineering Committee



PLANT SHUTS DOWN DAILY-

...yet holds high efficiency

CLOSE stabilization of water level is one of the factors permitting this utility plant to operate a Combustion Engineering Type VU boiler at 85-86 percent efficiency, despite an operating cycle which includes dead shutdown for eight to fourteen hours each night. Because of hydro-electric tie-in, the steam station generates only the amount of power required by industrial customers in excess of that available from the hydro system.

Rated capacity of the boiler is 100,000 pounds of steam per hour, peaks of 120,000 pounds per hour being carried for 30 to 45 minutes. During night shutdowns, the only steam generated is that bled through superheater tubes to keep them at proper temperature. Throughout the operating day, water level is held within plus-or-minus one inch by fully-automatic COPES Flowmatic Control.

The story is told in Performance Report Bulletin 455. Write for a copy—on your company letterhead, please.

NORTHERN EQUIPMENT COMPANY

1061 GROVE DRIVE, ERIE 6, PENNSYLVANIA

Feed Water Regulators, Pump Governors, Differential Valves. Liquid Level Controls, Reducing Valves and Desuperheaters.

BRANCH PLANTS: Canada, England, France

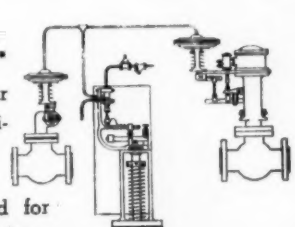
Representatives Everywhere

★GET CLOSER LEVEL CONTROL WITH COPES FLOWMATIC

DESUPERHEATER...

Here's a desuperheater every bit as effective on light loads as at full capacity. No water dribbles into the steam line. There is complete atomization of the cooling water from zero to full load because the opening of the spray nozzle—not the pressure drop across it—is varied with steam temperature. A self-contained unit, as *dependable* as the COPES Feed Water Regulator. Write for Bulletin 405-A.

MASTER CONTROL...



Remote control of reduced water or steam pressures, with single or multiple pressure reducing stations, is *dependably* accurate with the COPES Master Control. Adapted for excess pressure control in boiler feeding, where one or more turbine-driven pumps discharge into a common water header. Details on request.

Know-How or Know-Why?

Several years ago, a group of us were shown a gadget for testing mechanical aptitude. Something like lathe controls, it took both hands to operate, gave a rating based on 100 in ten minutes. We lined up several guinea pigs for test—all supposedly office workers. But among them we salted one fellow who was a former machinist, another who couldn't swing a hammer without smashing his thumb. The others tested from 21 for a clumsy girl to 65 for a skillful man.

Then we sprung our two jokers. Our clumsy man rated 9, the former machinist 85. "How about these two for machine operators?" one of us asked.

"You fellows tried to pull a fast one," said the inventor. "It didn't work—but you demonstrated something else you didn't expect to. *I wouldn't hire either one for a machine operator!* The man who got 9 had better stay away from tools or he'll hurt himself. The man who got 85 is a ringer—he has operated machines before. But the thing you didn't notice is that he only worked at making a high test rating for a few minutes. After that, he was busy figuring out how the tester operated so he could beat it."

"Is that bad?" we asked.

"Yes, for a machine operator. He'd never stay at it for long; he'd want a better job. I'd hire him, but not to run *machines;* I'd hire him to run *men.* You fellows ought to learn that old quotation: 'The man who knows *how* will always have a job; the man who knows *why* will always be his boss!'"

That experience has stuck in my mind, and I've used it in picking men ever since. It's in their eyes, their questions, their way of tackling a job. The topnotch turbine operator or watch engineer shows in short order he knows how to handle his job and is worth keeping on it. But if he makes it his business to find out why there's that little hum or why that bearing is heating, he's a man worth pushing up.

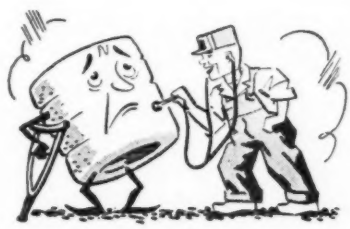
George Edwards

Engineer

The Stuffing Box

TIPS ON GOOD PACKING PRACTICE

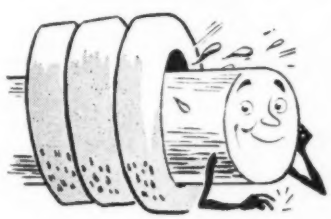
NO. 4 OF A SERIES



Used packing, if examined carefully, often points the way to better service from new packing. From it, you can learn much about the condition of your equipment and so find the solutions to many of your packing problems.

Here are some ways to check on trouble . . . and correct it:

Measure the thickness of the packing as removed from the stuffing box. If the rings have been compressed on the side

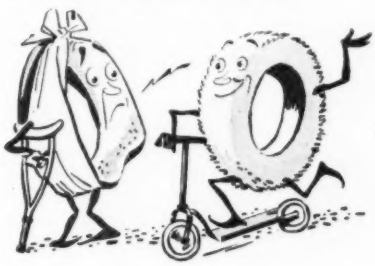


which lies directly under the rod, it indicates that the rod or shaft is out of line and riding the packing. This results in leakage around the top of the rod or stuffing box.

Applying excessive gland pressure when the rod or shaft is out of alignment will mean reduced packing life, rapid wear and scoring, and waste of power. The best remedy is to align the shaft.

If the rings next to the gland follower are badly deformed with the bottom rings in fair condition . . . look for improperly installed packings or excessive gland pressure.

Do your packings show a tendency to sheet out or extrude between the rod or shaft and the gland follower? If so, the gland pressure may be excessive, or, more likely, there is too much clearance between the rod or shaft and the gland follower.



A bulge in the side of one or more rings can safely be blamed on cutting the adjacent rings too short. This causes the packing to be forced under pressure into the open space.

Unusual wear on the outside diameter of the packing is probably due to one of two conditions (1) the rings are rotating with the shaft . . . (2) the packing is loose and moving with the rod.

A worn bushing in the bottom of the stuffing box sometimes causes extrusion of the packing into the system. When this happens, the fragments of packing may get into and clog valves or traps or contaminate the fluid being pumped.

Examination of the bottom ring will readily indicate whether or not this condition exists.

A dried and charred wearing face, with the rest of the packing in good condition, indicates insufficient lubrication. Remember that careful lubrication can do a lot to prolong the life of your packing.

For the right packing for your job, look for this sign. There are 400 conveniently located Johns-Manville Distributors throughout the country ready to supply you.

(For copies of Nos. 1, 2, and 3 of the Stuffing Box series, write Johns-Manville at the address below.)

It's good practice to use Johns-Manville

INTERLOCKED ROD PACKING

Because it's *braided square* of interlocked yarn, not braided round and *pressed* square, J-M Interlocked Packing lasts longer . . . presents a better contacting area . . . provides a tight seal with medium gland pressure. It's unusually flexible and resilient, too. J-M Interlocked is recommended for either reciprocating or rotating service, for use against steam up to 500°F., hot or cold, fresh or salt water; oils; weak acids and caustics. Johns-Manville, Box 290, New York 16, N. Y.

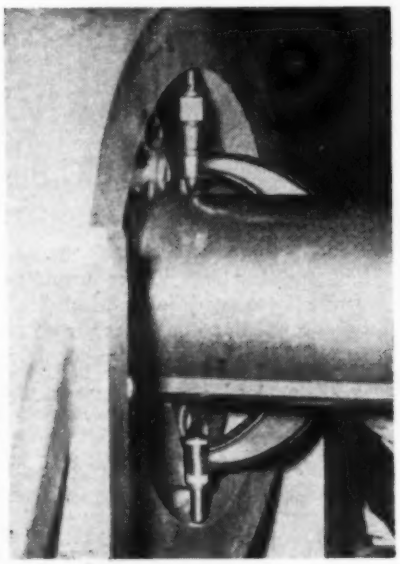
JM

EQUIPMENT *Continued*

Steam Cleaner

SINGLE, REMOVABLE subassembly for operating parts is one feature of a 4-valve vapor-steam cleaner. Two control valves —one adjusts cleaning mixture—enable one man to operate the machine.

Normal operating pressure for Model MO-46B, 100 psi, is developed by burning No. 1 fuel oil, kerosene or light oil in a down-draft burner employing an electric ignition system. Standard models operate from 110 v, 60 cycle, single phase. Overall dimensions are 18x48x48 in. Unit weighs 550 lb. Machine output reaches 100 gal of water per hr. **Dept P, White Engrg & Mfg Co, 157 West Passaic St, Rochelle Park, N. J.**

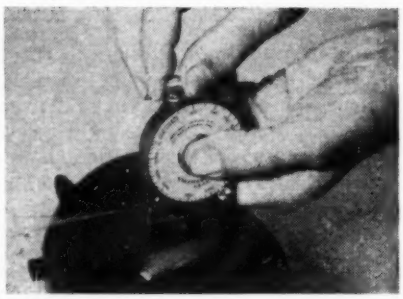


Tubular Micrometers

INSIDE MICROMETER with offset frame measures bore diameters without removing boring bars, shafts or piston rods. Device has hollow-box steel frame that makes it rigid, light and easy to handle. Standard size range runs from 8 to 28 in., with clear bar diameters of 4 to 8 in. Thus a 13½-to-18-in. set clears bars up to 7½-in. dia. Special micrometers for larger-sized bores are also obtainable. **Dept P, Tubular Micrometer Co, St. James, Minn.**

Panel Tachometer

ELECTRIC TACHOMETER serves where pickup unit or generator must be mounted permanently on a machine and the meter placed on a remote panel. Generator, which consists of *Alnico* magnet rotor mounted on ball bearings, is capable of continuous operation at any speed within meter limits. Meter is a rectifier type, including a *D'Arsonval* movement. Meters come in three sizes: 0 to 1250, 0 to 2500, and 0 to 5000 rpm. **Dept P, Ideal Industries, Inc, 1025 Park Ave, Sycamore, Ill.**

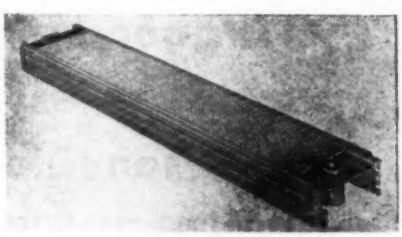


Reed Vibrometer

HANDY VEST-POCKET instrument operates on the tuned-reed principle and measures machine vibration or noise frequency. Steel reed, fed out from instrument case, snaps into sharp vibration when it comes into tune with machine vibration. Frequency in cycles per sec is read directly from a graduated dial. For noise analysis, reed is plucked and tuned to correspond to noise emanating from machine. Thus noise frequency can be read on the dial. **Dept P, Vibroscope Co, 6 East 39th St, New York 16, N. Y.**

Convector Radiation

A NEW, COMPLETE NON-FERROUS heating unit and additional inclosure types and sizes have been incorporated in Modine line of convector radiation. Headers, tubes and fins are copper or copper alloy. Universal header permits use of one style of heating unit on practically any 2-pipe steam or hot-water piping arrangement. Other features include adjustable brackets for quickly obtaining correct pitch and elevation of the unit and a choice of two air chambers for hot-water systems.



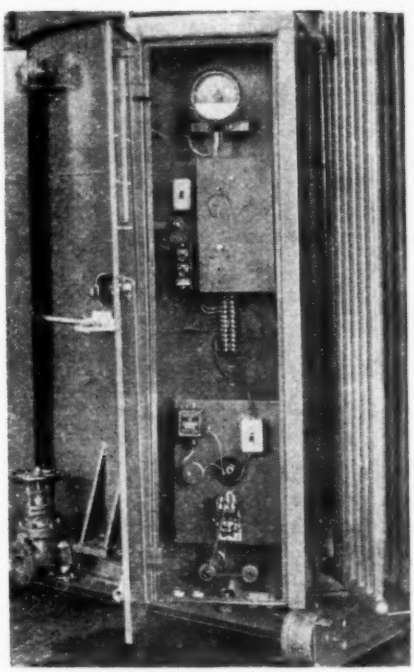
Flush-recessed style of inclosure, dropped during the war, has been reinstated. All recessed and floor-cabinet inclosures are now available in a 16-in. height required under low windows. In addition, the 3⅜-in. depth of convector has been included. **Dept P, Modine Mfg Co, Racine, Wis.**

Ground-Fault Neutralizer

NEW ELECTRIC ground-fault neutralizer is rated at 60 cycles, 115,000 v, 180 to 90 amp, "extended time." The latter feature means that unit is rated for continuous operation not to exceed 90 days per year.

Two thermostatically controlled 2.5-kw *Calrod* heating units are installed in bottom of tank to combat danger of congealing cooling-oil in neutralizer at below-zero temperatures. *Calrod* units, supplied by a 230-v 60-cycle power supply, are automatically turned on when oil temperature reaches –31 F. Unit operates at temperatures as low as –60 F.

Another novel feature prevents *Calrod* units from heating cold oil in neutralizer's radiator tubes. Tank is designed so that when oil temperature reaches –31 F, oil has contracted in volume and its level is below top of radiator tubes, thus preventing circulation. By heating only oil in tank, a saving is realized. **Dept P, General Electric Co, Schenectady 5, N. Y.**

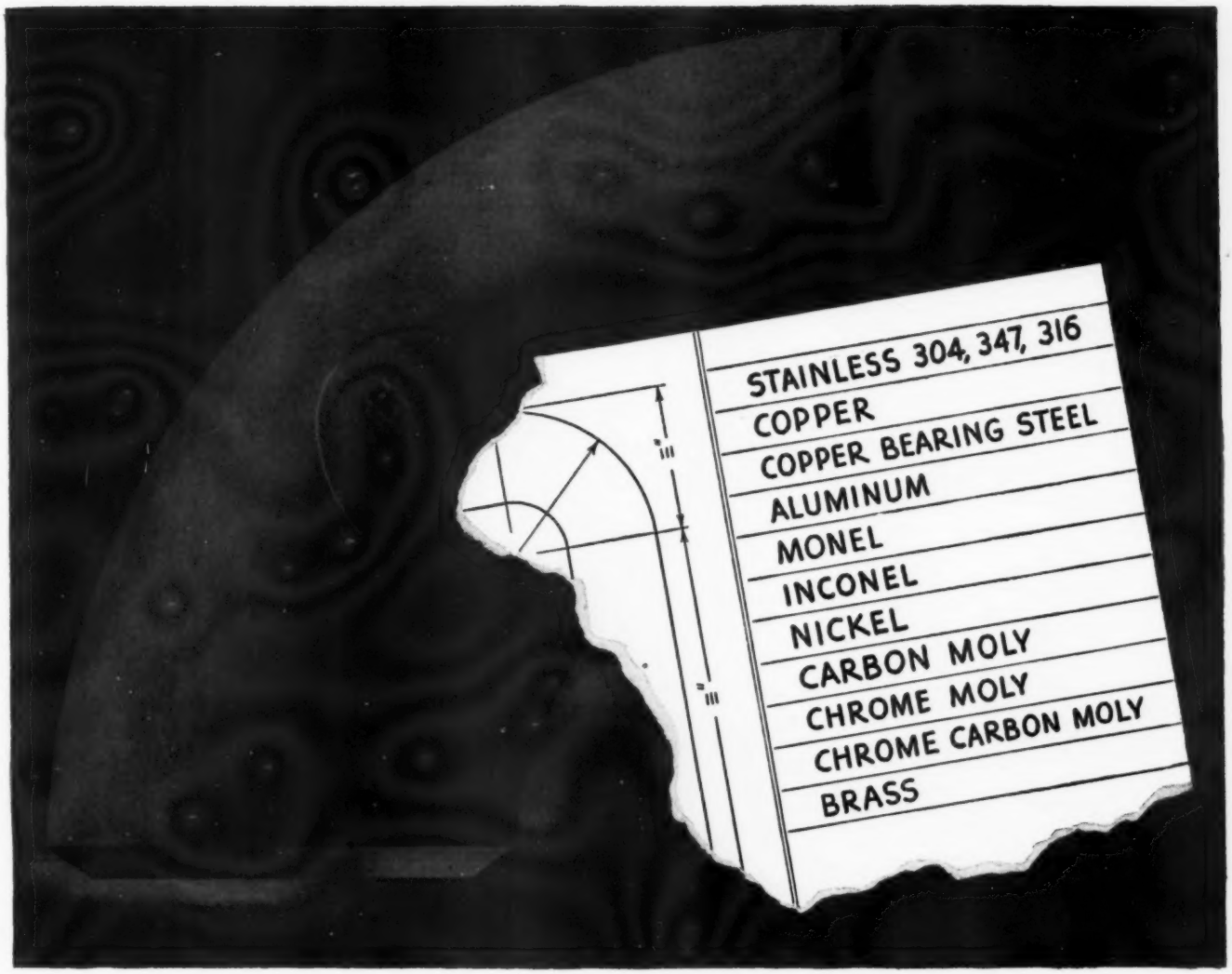


Sight-Feed Valve

DEVICE CONSISTS of an unbreakable plastic sight and a combination set-screw and hollow-lock-screw flow adjuster. It serves wherever the rate of oil flow must be visually checked and regulated—circulating oil systems or bearing feed. Flow can be adjusted from a drop feed to wide open. Glass sights are available for temperatures above 150 F. Oil-Rite valves come in male and female pipe sizes of ⅛, ¼, ⅜ and ½ in. **Dept P, Oil-Rite Corp, S 13th St, Milwaukee, Wis.**

(*Continued on page* 164)

POWER brings this monthly survey of new equipment as one of its many reader services. In requesting additional information from manufacturers, please identify the source of your inquiry by referring to Dept. P.



Which Alloy?

TUBE-TURN quality-controlled Welding Fittings and Flanges are available in a wide range of metals and sizes to meet virtually every piping need. Practical production and application experience has dictated the engineered development of every fitting design. The selection of each alloy was made only after careful research and close cooperation with alert piping engineers all over the country whose daily problem is to cope with specific conditions of heat, pressure, flow and corrosive attack.

Not just another fitting . . . but one which meets, in every way, the rigid requirements of planned, long-lived systems . . . systems in which every component part plays an important role.

Tube-Turn engineers are ready to work with you and give you the benefit of their wide background of experience in the use and production of welding fittings in all these alloys. For piping permanence in alloy systems, be sure the Welding Fittings and Flanges are trade-marked Tube-Turn.

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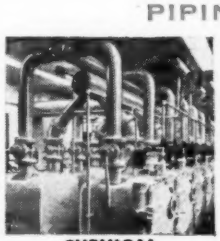
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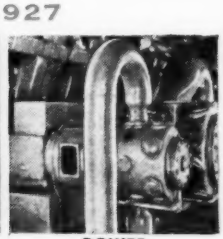
GENERAL PIPING

SHIPBUILDING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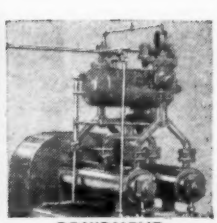

EQUIPMENT

POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
WASHINGTON NOTES • NEW DEVELOPMENTS • CONVENTIONS

17th National Power Show Promises Wide Review

► POWER-FIELD MANUFACTURERS apparently plan to make the most of the opportunity the 17th National Exposition of Power and Mechanical Engineering offers, for over 300 have already engaged space for the exposition at Grand Central Palace, New York, Dec 2-7, 1946.

Present indications point to major emphasis on equipment for both production of power from fuel and power transmission to machines, with some phases of power utilization appearing. Exhibits already decided include (1) model of first U. S. gas turbine actually proposed for power generation in the utility field (2) small diesel-electric unit designed for portable use and small isolated plants (3) "packaged power" or self-contained boilers of the type usually assembled in sizes from 2000-20,000 lb per hr.

In addition, the show will feature power-plant auxiliaries, such as new apparatus for pulverizing coal, and burners capable of firing coal, gas and oil, selectively or in combination, with controls that permit a degree of fineness not hitherto obtainable. Also promised for display are soot blowers, chemical feeders, heat exchangers of many types, instruments and gages, as well as other items contributing to plant economy.

Power From Atom Compared With Coal

Staff of the Monsanto Clinton Laboratories and the engineering department of Monsanto Chemical Co under the direction of Dr C A Thomas, vice-president and technical director of the chemical company, completed a study designed to show whether or not cost of nuclear power is in a range to encourage development by industry.

A report based on conclusions of that study has been submitted to the United Nations Atomic Energy Commission by Bernard M Baruch, U. S. representa-

(*Continued on page* 186)

Technical Advances Mark New Diesel Locomotive

First of an entirely new line of diesel-electric locomotives to be assembly-line produced by American Locomotive Co at Schenectady, and 75,000th locomotive built by that company, this 6000-hp unit is one of seven for the Santa Fe.

The locomotive consists of three cabs, each containing a single 2000-hp engine and auxiliaries. The newly designed engine, with General Electric constant-pressure supercharging, boasts smallest displacement per unit of output in the locomotive field. With charging pressure at about 20 psi and turbine pressure at 15 psi the 16-cylinder 9x10.5-in. 1000-rpm 4-cycle V-type engine operates at 140 bmep. The supercharging system, developed for aircraft, boosts output of engine by more than 80%, bringing its weight down to about 18 lb per hp

COMING EVENTS

Oct 3-5—National Electronics Conference & Exhibit, Edgewater Beach Hotel, Chicago. National Electronics Conference Publicity Committee, Chicago 6.

Oct 24-26—Joint meeting, Bellevue-Stratford Hotel, Philadelphia. Fuels Div of ASME and Coal Div of AIME; N E Funk, % Philadelphia Electric Co, Philadelphia, Pa.

Oct 28-30—Seventh Annual Water Conference, Wm Penn Hotel, Pittsburgh. Engineers' Society of Western Pennsylvania; K F Treschow, secy, Wm Penn Hotel, Pittsburgh, Pa.

Oct 29-Nov 1—All-Industry Refrigeration Show. Public Auditorium, Cleveland. Refrigeration Equipment Manufacturers Assn; R Kennedy Hanson, secy, 1107 Clark Bldg, Pittsburgh, Pa.

Nov 18-22—National Metal Exposition, Municipal Auditorium, Atlantic City, N. J. Chester L Wells, 7301 Euclid Ave, Cleveland 3, O. Following are holding annual meetings in Atlantic City at same time: American Society for Metals, Traymore Hotel (headquarters); Iron & Steel Div and Institute of Metals Div, American Institute of Mining & Metallurgical Engineers, at Claridge Hotel: American Welding Society, at Ambassador Hotel.

Dec 2-7—17th National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York. Charles E Roth, exposition manager, Grand Central Palace, New York. Annual meeting of ASME will be held at this same time at the Hotel Pennsylvania, New York.

CHAPMAN

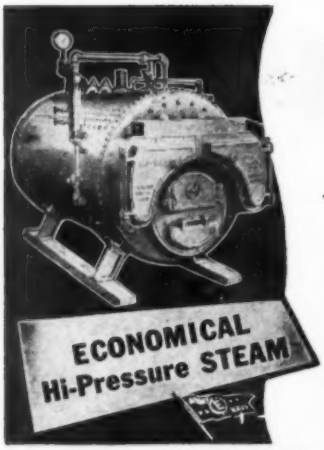
LIST 960

Small Gate Valve

The Chapman List 960 Small Gate Valve may be employed safely in exposed locations, because it is fitted with a flanged forged steel packing gland to protect the threads on the valve yoke from rust and corrosion. It opens and closes quickly—will give no trouble by sticking or freezing. Seats and plugs can be super-hardened for extra severe services.

In sizes from ¼" to 2"—in carbon steel for pressures to 800 pounds at 750°F. (Specify List 990 for higher pressures.)

The CHAPMAN Valve Manufacturing Company
INDIAN ORCHARD, MASSACHUSETTS



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for Temperature Shock

Heated to a temperature of 425°F and then plunged into ice water creates several times the thermal shock that any gauge glass is called upon to withstand. Yet that is a routine test for Pyrex Gauge Glasses. That is only one of the reasons why they stand up under actual service conditions.

Machine drawn accuracy that permits easy installation and reduces to a minimum installation strains that cause breakage, remarkable resistance to the solvent action of hot water or steam, a hard smooth surface that resists abrasion and scratching—are other factors which make Pyrex Gauge Glasses the most economical glass you ever used. Corning Glass Works, Corning, N. Y.

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CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

Cooling Tower

(*Continued from page* 106)

cost rises with the number of subdivisions so that an economic limit restricts this number. This economic limit occurs at about six subdivisions (19 rows of fill = 3[z] + 1) and, in fact, few towers, even for extreme conditions, have more than this number. If a selected tower of a given height with 19 rows of fill gives insufficient surface for required performance, tower height itself must be increased.

One other factor in surface considerations, average drop diameter, would enable determination of total drop surface if it were known. Unfortunately, drop diameter varies with loading, that is, with the amount of water for square feet of ground area. It increases with loading because drops coagulate. Beyond a certain loading, coagulation becomes so large that sheets of water form. Surface area, of course, drops sharply. This is the flooding point of the tower.

As already stated, a cooling tower is a heat exchanger for transfer of heat between water and air. Two sources of heat exist: (1) temperature difference between the water and air forming a conductive heat flow and (2) evaporation and flow of vapor from water into the air. In design considerations these two heat streams are combined by introducing a factor called enthalpy potential. A so-called cooling-tower equation develops that states total heat exchanged is proportional to (1) diffusion coefficient (2) enthalpy potential difference between the streams and (3) the exposed surface.

WET BULB TEMPERATURE

From such design data it becomes evident that in a cooling tower not air temperature but air enthalpy determines performance. Since air of different temperatures and relative humidities, with the same wet-bulb temperature, have very closely the same enthalpy, performance of a tower is determined by wet-bulb temperature alone. Dry, hot desert air has the same cooling effect as colder, moist air if both have the same wet-bulb temperature.

Cooling-tower specifications carry hot- and cold-water temperatures, wet-bulb temperature and amount of water to be cooled. A manufacturer also specifies amount of air through his tower. With this information, corresponding tower characteristics of competitive proposals can be determined by the graphical

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Whatever your needs may be, there's a Super-Silvertop that fills the requirements. Find out more about these Anderson steam traps—write today for *your* copy of "How To Choose a Steam Trap".

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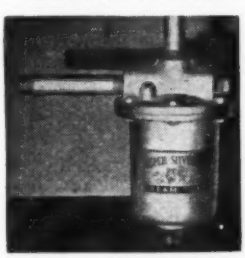

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NON-CORROSIVE STEAM?

CORAVOL *Saves* YOU COSTLY

PIPE REPAIRS, REPLACEMENTS, MAINTENANCE LABOR, HOURS AND DAYS OF SHUTDOWN LOSS

CORAVOL in your steam system (1) prevents corrosion in steam and condensate lines, (2) cleans out clogging rust deposits resulting from previous corrosion. Thus, **CORAVOL** *protects lines;* increases effectiveness of heat transfer surfaces; restores original capacity of lines and the operating efficiency of valves and traps.

CORAVOL is *not* a boiler feed water treatment—it is designed expressly for use in steam systems. Because **CORAVOL** volatilizes and condenses with the steam, it circulates thruout your entire steam system and protects *all* zones from corrosive attack.

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presentation of the cooling-tower equation, page 106.

Before discussing the role of a cooling tower let us consider ground area, a factor that many engineers hold important in tower performance. Some feel it so important they prefer a tower of large ground area to a smaller one. To best understand this factor it may be useful to give an example showing effect of ground area on the characteristics of two towers handling the same quantities of air and water with similar fill design, same height and number of falls.

Cooling-tower tests show that (1) diffusion coefficient depends upon air-mass flow (2) surface varies with loading and (3) tower characteristic, with fixed tower height and fill layout, depends only on a ratio between water and air flows. With the towers as described above and with different ground areas, the tower characteristics expressed as a ratio vary inversely to the ground area.

In other words, the tower of smaller ground area has a large characteristic, and is capable of greater cooling. This follows from a consideration that a smaller tower requires higher velocity and loading than a larger one so that higher diffusion coefficient and surface result. Pressure drop, however, in a smaller tower must be larger, with more power for fans supplied.

TOWER COMPARISONS

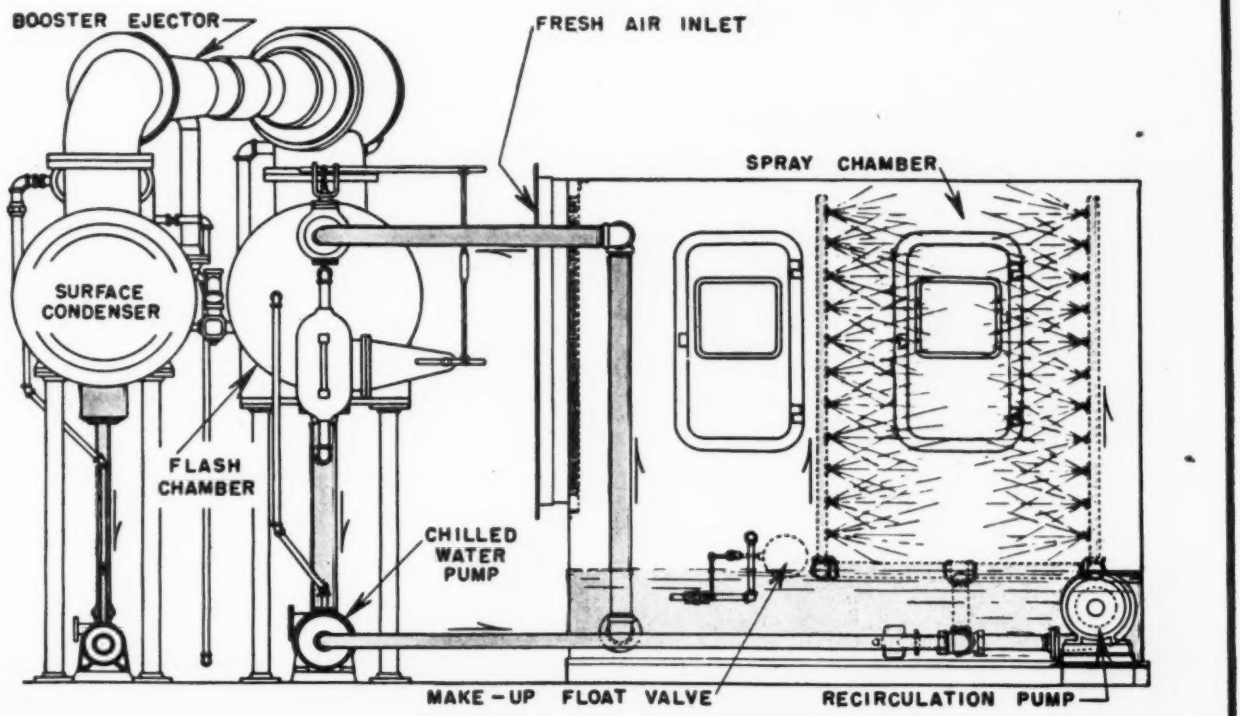
With the foregoing for background, let us compare two competitive bids. Each bid must be based on the same amount of water to cool, same cooling range and wet-bulb temperature. Towers differ, however, in height, number of falls, ground area and air-mass flow. The cooling-tower equation, already referred to, shows these factors and enables a ratio to be determined graphically between the two tower characteristics. This ratio, fixed by design conditions, must meet those that cooling conditions impose.

If two towers are radically different in design, variations of diffusion coefficient with air-mass flow, and of fill shape with water load, differ so widely that they cannot be compared.

In most instances fill design and shapes are sufficiently alike to allow the assumption that these functions, coefficient of diffusion and fill shapes, are roughly the same in any two towers. Then with these stated conditions and assumptions, R ratio of characteristics for towers 1 and 2. =

$$\frac{A_2}{A_1}\left(\frac{G_1}{G_2}\right)^y \sqrt{\frac{H_1 Z_1}{H_2 Z_2}}$$

in which A is ground area of both towers; G represents their air-mass flow;



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Vacuum refrigeration systems cool water by subjecting it to high vacuum. This high vacuum is created by steam jet air ejectors which flash a small percent of the warm supply water, remove it as vapor, thereby cooling the remaining water to temperatures as low as 40 deg. F. Cool clean water, the refrigerant used by Foster Wheeler vacuum refrigeration is the safest and cheapest coolant for the modern plant.

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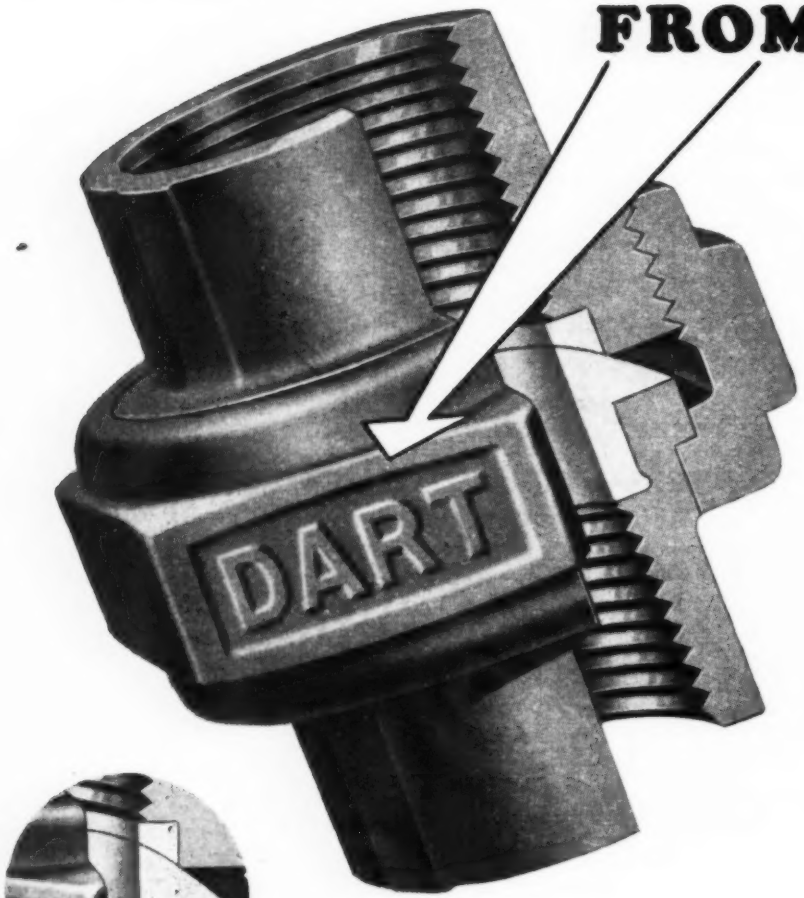

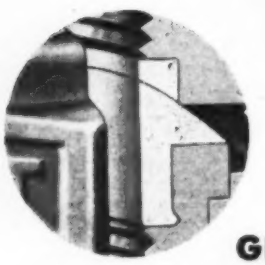

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DART UNIONS

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H, height; Z, number of falls in each.

Careful tests on Foster-Wheeler towers indicate $y = \frac{1}{2}$. Substituting this in the above formula we get a much simpler expression:

$$R = \frac{A_2}{A_1}\sqrt{\frac{G_1H_1Z_1}{G_2H_2Z_2}}$$

If the right side of this equation should be larger than R determined by cooling requirements, tower 1 would enjoy a greater safety factor for performance, and vice versa. It must be stressed, however, that this equation applies only to towers of very similar fill design.

Pumps Q and A

(*Continued from page* 122)

Fig. 10, forms a passage from cylinder's bottom to outlet in valve deck. A wet liner must have strength to withstand external loading of full discharge pressure throughout most of its length when piston approaches bottom of stroke.

Q 14—*What is a follower liquid piston?*

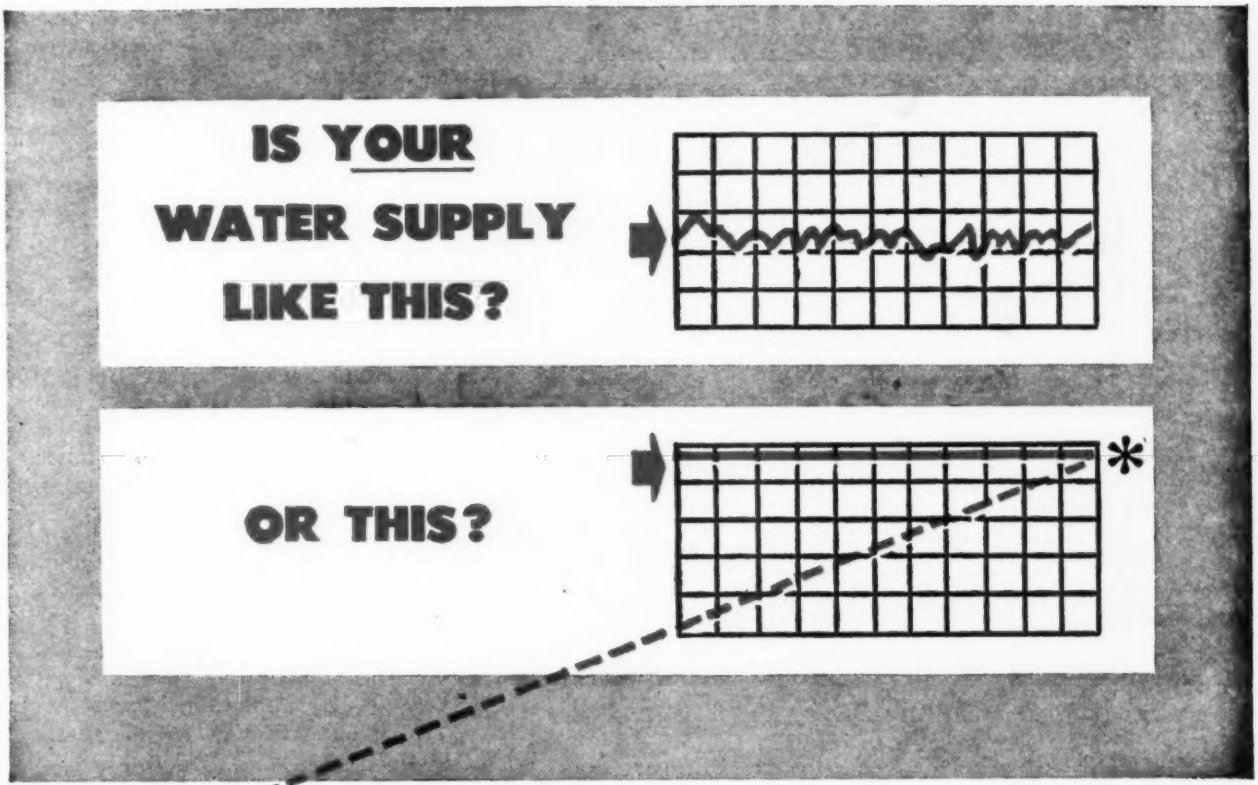
A—At one end it has a plate or follower, removable for packing replacement without disturbing piston body. Fig. 1, 4 and 9. In smaller sizes a single piston-rod nut holds both follower and piston in place on the rod, Fig. 1 and 9. In larger sizes such a nut bears directly on piston body; separate studs and nuts, Fig. 4, hold follower plate in place. On vertical pumps the follower plate is often on top side of piston to permit repacking from above without disturbing anything but top cylinder head and follower plate.

Q 15—*What is a solid liquid piston?*

A—Groove or grooves cut in the solid body receive the piston packing. To renew it, piston must be withdrawn from cylinder. Solid pistons are often used on heavy-duty pumps where piston-rod size and packing-groove depth make it impracticable to use a studded follower plate or to remove a large and extremely tight piston-rod nut to repack piston.

Q 16—*What is a wet-vacuum pump?*

A—It is a special form of submerged piston pump, Fig. 11, generally used with reciprocating condensing steam engines to remove both air and condensate from condenser hotwell. Cylinder is lightweight because of low discharge pressure. It has large passages and considerable space between suction and discharge valves so air may collect



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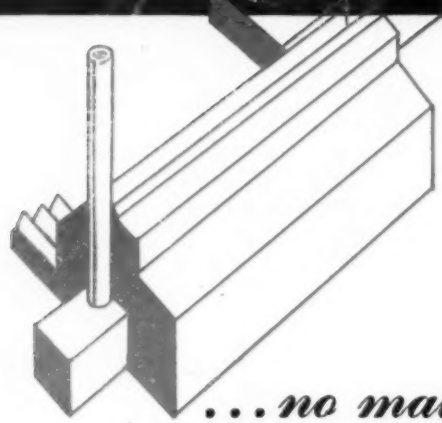

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Schramm Air Compressors are specified by industry today because they furnish all the air you want, whenever and wherever you want it. Each unit is tested before it leaves the factory, and goes to work as soon as it is installed.

Both stationary and portable units are available, in every size mounting and assembly. A new Booklet giving full construction details and advantages you get with Schramms is yours for the asking. Write us today for your copy.

SCHRAMM INC.

THE COMPRESSOR PEOPLE
WEST CHESTER
PENNSYLVANIA

152 (718a)

under the discharge valves with minimum mixing with the water that fills the clearance volume. Suction connection is usually on the valve deck's top to permit a straight drop from condenser hotwell to pump's suction chamber. Suction valves are sometimes set at an angle to permit free air flow from suction valve's higher side to discharge valve's bottom.

Q 17—What materials are used for the liquid end of a direct-acting pump?

A—Most direct-acting pumps have cast-iron cylinders, heads, valve plates and covers, and bronze piston rods and valves. Liquid pistons may be either cast iron or bronze. Rubber valves are often used for low-pressure service and for vacuum pumps. Stainless steel is used for valves and seats; piston rods are often of stainless steel or monel metal. All bronze fluid ends are used for acid mine water and for salt water where electrolytic action causes rapid deterioration when dissimilar metals are present. Fluid ends are all-iron for certain alkalies and for oil.

Reader's Problems

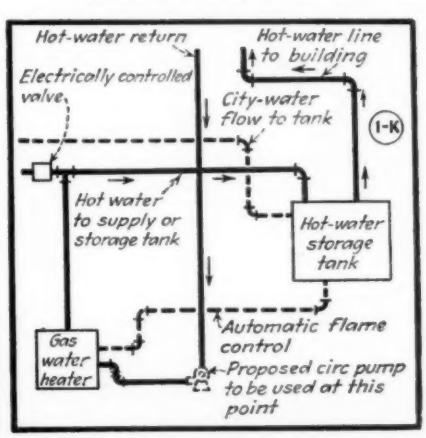
(*Continued from page* 117)

Try Water-Level Control

I BELIEVE WARM-WATER PIPE from tank to heater and the proposed circulating-pump installation could be better located. In 1-*K* hot water goes from gas heater to tank, then to hot-water supply main. Water that isn't used returns to suction side of pump and is discharged through heater to storage tank. To get the most out of hot-water system I added two controls to *ELB's* hookup, see sketch.

Flame should be controlled according to temperature of water in the tank.

(*Continued on page* 154)



A Candle Won't Broil a Steak

—and neither will inadequate wiring run electrical equipment at FULL CAPACITY

Wire ahead!

IF A MACHINE is running 1500 RPM, and it should run 1800 RPM, don't blame the operator. Chances are that *reduced voltage* is curtailing the machine's production. In fact, inadequate wiring can reduce efficiency as much as 25% to 50%!

Check up now on your *real* power needs! Don't let obsolete wiring handicap expensive production equipment. Remember that emergency alterations later may cost much more than foresighted wiring improvements today.

Talk it over with consulting or plant power engineer, electrical contractor or power salesman. They'll advise: Wire Ahead! Anaconda Wire & Cable Company, Subsidiary of Anaconda Copper Mining Company, 25 Broadway, New York 4, N. Y. Sales Offices in Principal Cities.

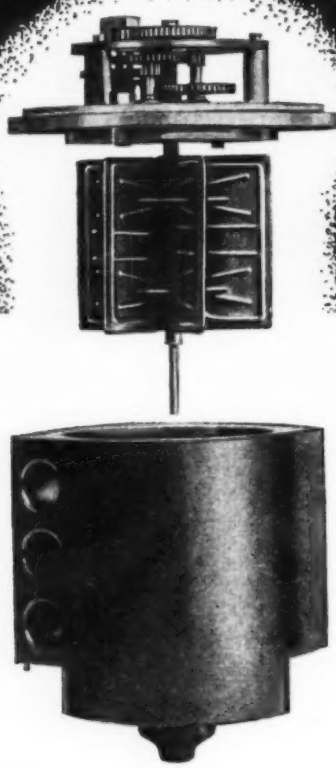
Look to Anaconda for wire and cable controlled from copper ore to finished product by Anaconda basic research and engineering. Every Anaconda product is a lasting investment . . .

Check your wiring plans before they check you!

DON'T BE PENNY-WISE AND POWER-FOOLISH

ANACONDA **ANACONDA WIRE & CABLE COMPANY**

BUILT TO TAKE PUNISHMENT



HENSZEY *Feed Water* METERS

Notice the simplified, rugged construction of the inside mechanism of the Henszey Meter. The rotor (directly connected to the gear train) fits into the measuring chamber without close clearances. Bearing surfaces, shafts and bushings subject to friction and hard wear are made of tough, long-wearing Stellite. Calibrations of the straight-reading horizontal register can be made to read in gallons, pounds, or cubic feet at any specified temperature.

Yes, that's why Henszey Meters are used for dependable, accurate measurement of boiler feed water, boiler blowdown, condensate, chemicals and other similar liquids. Send for bulletin.

HENSZEY CO. Dept. D10, Watertown, Wis.

HENSZEY

FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Flow Indicators • Boiler Feed Regulators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

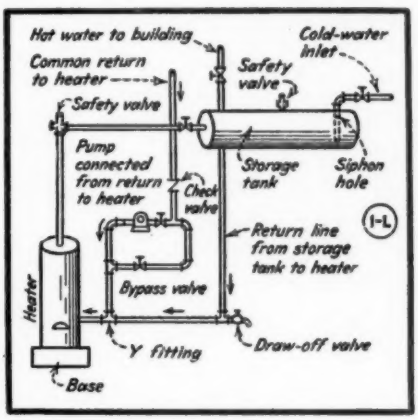
If minimum temperature is 10 F below normal, the flame would be at its highest point when demand is high. When water temperature is normal, flame could be either out or low. City water should be admitted to system when the level in storage tank gets to a low point selected by the chief engineer.

Philadelphia, Pa. T F CUNNINGHAM

Pump Improves System

I BELIEVE *ELB's* hot-water system is incorrectly connected. Sketch 1-*L* shows correct hookup for heater and storage tank.

Installation of a pump has an economic as well as a practical value.



Heated water is returned to the storage tank at a high temperature. This saves hot water and assures a better supply.

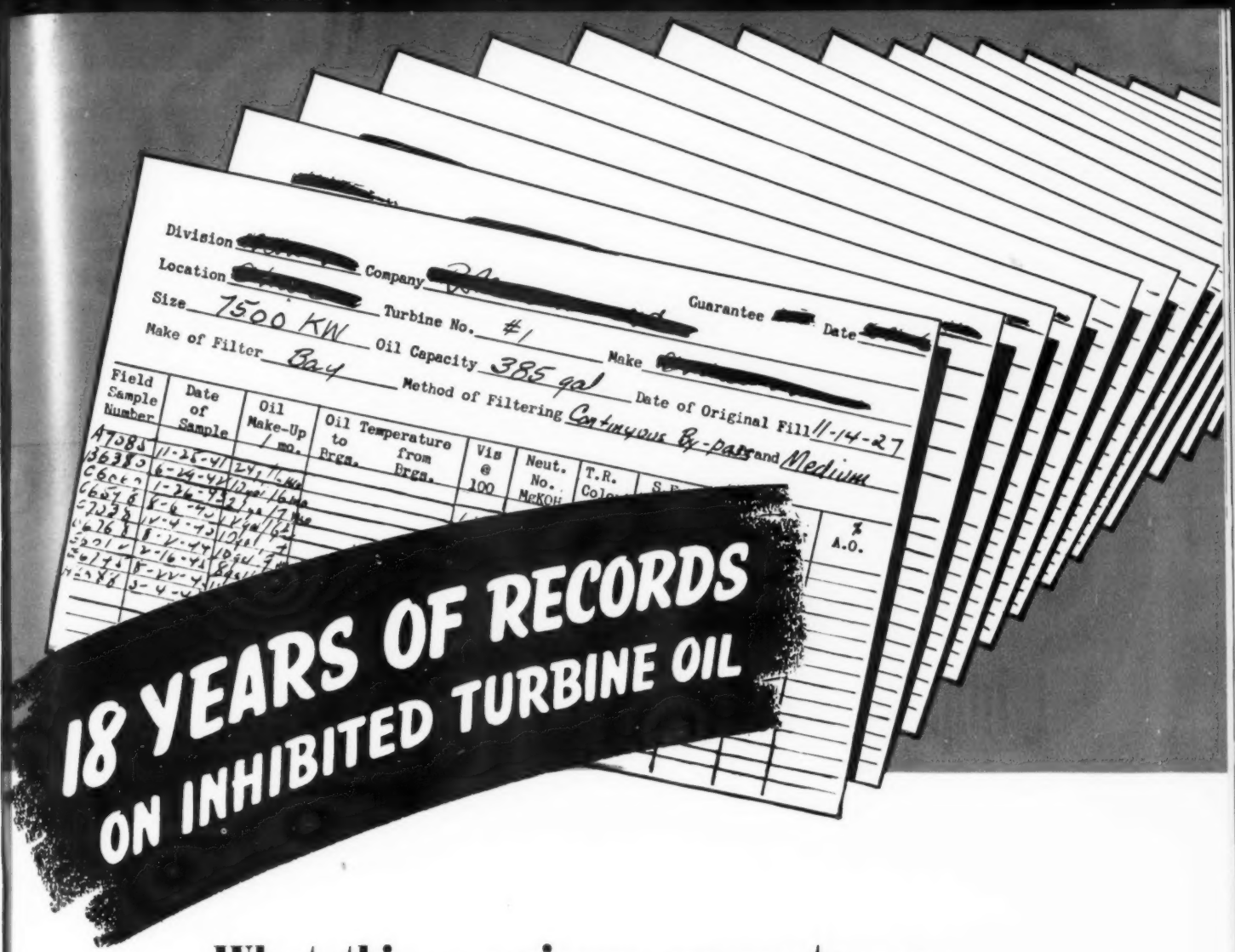
Pump is installed in circulating return main as close to heating unit as possible. Return connects to inlet side of pump, and outlet side connects to return to heater. It is advisable to install a bypass also.

If pump gets out of order control valves can be closed and hot water will circulate around the pump. This is a temporary means of water circulation. When the bypass is not in use, its valve must be closed.

Oaklyn, N. J. C A WILKES

Hot Water Short Circuits Along the Top of Tank

THE PROPOSED INSTALLATION of a circulating pump in *ELB's* hot-water system will not solve his problem. His system should be piped as in 1-*M*, p 158. Cold water should enter the heater instead of the storage tank. *ELB's* cold water enters bottom of storage tank at one end. It flows along bottom to opposite end to supply pipe for heater. Hot water from the heater enters top of storage tank, directly opposite the cold water inlet. Hot-water supply



What this experience means to you...

Since the first fill of oxidation-inhibited, guaranteed Nonpareil Turbine Oil was installed 18 years ago, records have been kept of its operation in every installation made. Oil samples are checked periodically at Standard Oil Laboratories for acidity, demulsibility, viscosity and other significant qualities. Few, if any, oils have as long or complete a record of their performance in service as is available on Nonpareil.

To users of Nonpareil these records give complete assurance that the oil in a turbine is living up to its guarantee not to increase in acidity and that demulsibility and contaminants in the oil are well within safe limits. To prospective users of Nonpareil these records show that Nonpareil has met all requirements, regardless of the changes and improvements in turbine design, over the years.

In addition, if you are interested in an oxidation-inhibited oil, a Standard Oil Lubrication Engineer can give you all the facts based on 18 years of recorded experience with hundreds of installations to prove that oxidation-inhibited Nonpareil Turbine Oil will eliminate excessive acidity formation, reduce sludge and deposits to the point where Nonpareil will never require replacement or even removal for treating. Standard Oil Company (Indiana), 910 South Michigan Ave., Chicago 80, Ill.

NONPAREIL
TURBINE OIL

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

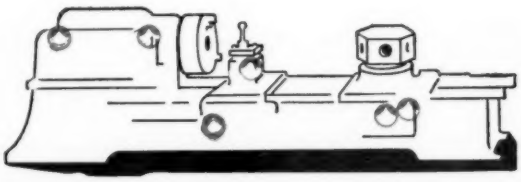
CODED LUBRICATION

tells your oilers 4 important facts... with simple numbers

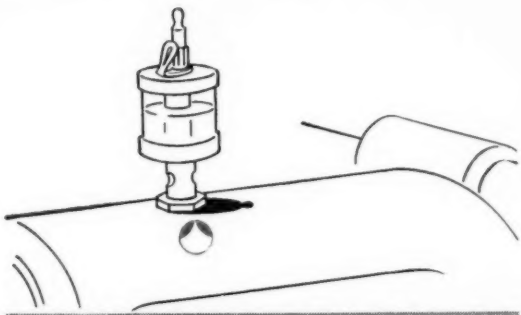
TROUBLED with getting the right lubricants in the right places? Standard's Coded Lubrication Service can help you. And it's easy to install and simple to follow.

Code numbers, not colors, are assigned to each lubricant used in your plant. Numbered decals are applied at each point to be lubricated, indicating which lubricant is to be applied. Every grease gun, oil can and storage container is numbered to indicate what lubricants are in them. Your oilers simply follow the numbers without having to remember brand names and grades.

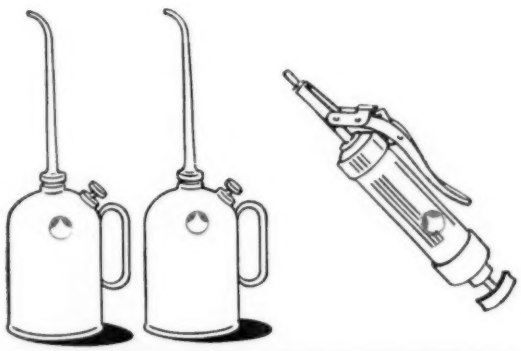
A Standard Oil Lubrication Engineer will be glad to discuss the application of Coded Lubrication in your plant. Call the nearest local Standard Oil office or write 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.



1. Where lubricant is needed



2. Which lubricant to use



3. Which oil can or grease gun to use

4. Which lubricant is in each storage container

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE

Only RIC-WIL STEAM CONDUIT *gives you ALL these advantages*

1. High-rating thermal insulation of required thickness applied to 21 ft. pipe—with sealed air space between insulation and housing.
2. Structurally strong, shock proof conduit housing seam-welded and hot-dip galvanized—permitting installation in shallow trenches.
3. Double coating of high melting-point asphalt, reinforced with felt wrapper—assuring long life and low maintenance.
4. Stuffing-box preseal rings on ends of conduit protect against water damage during construction—permitting installation regardless of weather or trench conditions.
5. Simplified connector speeds coupling of 21 ft. prefabricated sections in the field and facilitates making welded closures.
6. Full-welded conduit design and field-welded connections insure pressure-tight system. Air test may be applied before backfilling.

When specifying conduit for underground (or overhead) steam distribution lines insist on Ric-wiL to obtain these features for the most efficient, maintenance free, permanent system.

All-welded construction means a pressure-tight conduit capable of meeting air-pressure test. Conduit casing is 16-gage corrugated iron, seam-welded and hot-dip galvanized after welding. Simplified connector is readily welded to smooth conduit ends, held in place by drive clamps . . . *Ends of conduit are presealed* at the factory with a heavy pre-cast cylinder to protect insulation during storage on the job and installation—regardless of water conditions encountered . . . *Triple protection against the elements* is insured by Ric-wiL specifications for conduit covering. First, a thick coating of high melting-point asphalt is applied over casing. Second, asbestos felt is tension wrapped around conduit before asphalt is set. Third, another coating of asphalt is applied, which is finally protected by spirally wrapped heavy kraft shipping paper . . . *Installation is greatly simplified,* saving time and money on the job. Prefabricated 21 ft. sections, also prefabricated accessories—including expansion loops, elbow, tee-branch and anchor units, are furnished with ends fitted for easy coupling in the field. Because of the conduit's inherent strength, only 18" of ground cover is required, even under trucking roads, minimizing excavation and back-fill. Pipes can be turned in conduit so that all pipe welding is done on top. Installation interferes little or none with other construction.

If you have not yet used the full-welded Ric-wiL Prefabricated Insulated Pipe Units, specify them on your next job and be assured of the best. Descriptive Catalog on request.

RIC-WIL INSULATED PIPE CONDUIT SYSTEMS
THE RIC-WIL COMPANY · CLEVELAND, OHIO
AGENTS IN PRINCIPAL CITIES

STEAM REDUCING VALVES

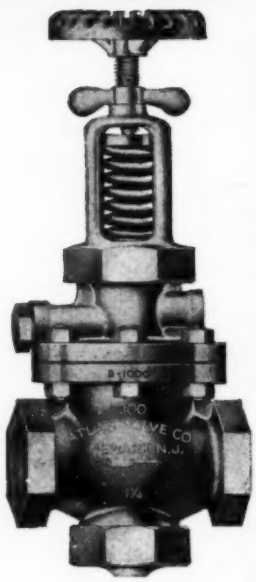
ATLAS

TRADE MARK REG

Here we show our →

Type "B"

which is unequaled for services requiring tight seating and uniform reduced pressure.



With ATLAS Type "B," wide fluctuations in initial pressure have practically no effect on the reduced pressure because of the pilot operation. Renewable piston chamber, internal pilot valve, and main valve strainers. Main valve disc seats tight because disc stem is guided by center bearing cast integral with seat ring. Control diaphragm and controlled pressure port are integral with the valve body. The main valve is caused to open wide and close tight with slight changes in the reduced pressure through the operation of the pilot.

This excellent valve is also simple to maintain. Main valve disc and pilot valve are easily removed for cleaning or regrinding. The entire pilot valve can be lifted out by merely removing diaphragm cap and unscrewing pilot valve seat.

For 250 lb. Service Iron Body

Flanged Ends — Bronze or Nickel Alloy Seats and Valves — Pilot Operated. For initial working pressures from 20 to 250 lb. saturated steam: for reduced working pressures from 1 lb. to within 20 lb. of initial pressure in one stage. Sizes: 2½", 3", 4", 5", 6", 8".

For 300 lb. Service All Bronze

Screwed or Flanged Ends — Bronze or Nickel Alloy Seats and Valves — Pilot Operated. For initial working pressures from 25 to 300 lb. saturated steam: for reduced working pressures from 1 lb. to within 20 lb. of initial pressure in one stage. Sizes: ½", ¾", 1", 1¼", 1½", 2".

For 400 and 600 lb. Service with Temperatures To 900° F, Steel Body

Series 40 for steam service to 400 lb.
Series 60 for steam service to 600 lb.

Monel Metal, Stainless Steel and Nitralloy Seats—Stainless Steel Piston and Piston Chamber — Flanged Ends — Pilot Operated. For reduced working pressures from 1 lb. to within 30 lb. of initial pressure in one stage. Designed and built to withstand severe corrosion and wearing service under high pressure and temperature conditions. Sizes: ½", ¾", 1", 1¼", 1½", 2", 3", 4", 6".

Write for Bulletin No. 1 A.

This bulletin tells all about Type "B". Also, for other ATLAS products check the following list and mail to us with your name, firm name, and address.

- ☐ Damper Regulators
- ☐ Temperature Regulators
- ☐ Exhaust Control Systems
- ☐ CAMPBELL Boiler Feed Water Regulators
- ☐ Pump Governors
- ☐ Pressure Regulators
- ☐ Float Valves
- ☐ Oil Control Cocks
- ☐ Humidity Controllers
- ☐ Thermostats
- ☐ Balanced Valves
- ☐ Control Valves

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REGULATING VALVES FOR EVERY SERVICE

Specialists in Regulation for Nearly a Half Century
289 SOUTH ST., NEWARK 5, N. J.

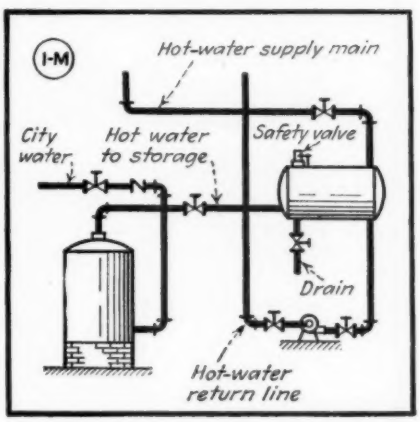
Representatives in Principal Cities

main to the building is connected to storage tank at opposite end. Since hot water is lighter than cold, it short circuits along top of storage tank, to the building supply main.

ELB is not taking full advantage of his storage capacity. Instead of having a tank full of hot water, he has hot water only in the top portion of tank, while the bottom contains cold or, at best, only warm water. As soon as the demand starts in the morning, the small amount of hot water is exhausted, and the heater starts acting as an instantaneous heater.

There is no particular advantage in the cold water entering the storage tank first, and then the heater. The same number of heat units have to be added to raise water to desired temperature. *ELB* also has poor circulation with the return piping. Circulating line should connect directly to storage tank as shown.

Hopewell, Va. C A HALL.



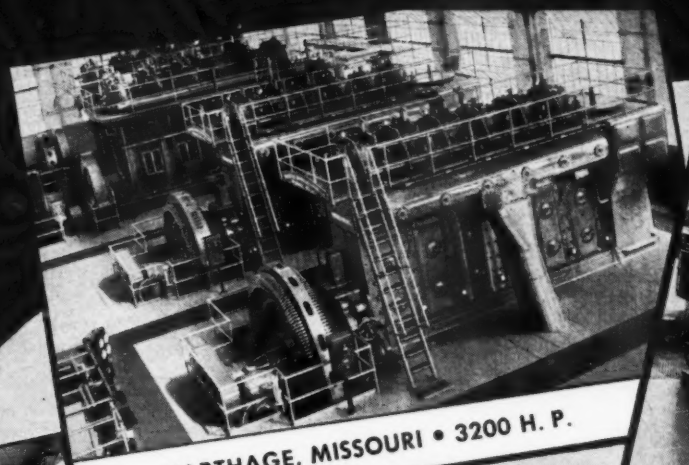
Clean Hot-Water System

A FEW YEARS AGO I ran into a situation similar to *ELB's* in a 5-story dormitory. We found several return lines stopped with scale and rust. The submerged heater tubes were filled almost solid with scale. After cleaning out return lines and heater tubes we had no more trouble.

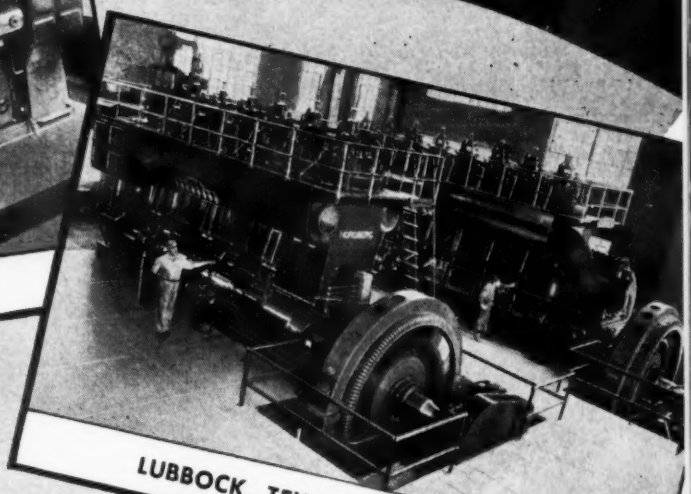
I believe if *ELB* cleans out return lines and heater he will have plenty of hot water provided his heater is large enough. I also suggest he install a valve between city-water supply line and return line so the return line can be flushed out without shutting off the city supply. Flushing out return lines about once a week helps keep them free of sediment.

His present piping system should give good results if the heater and pipes are large enough and kept clean.

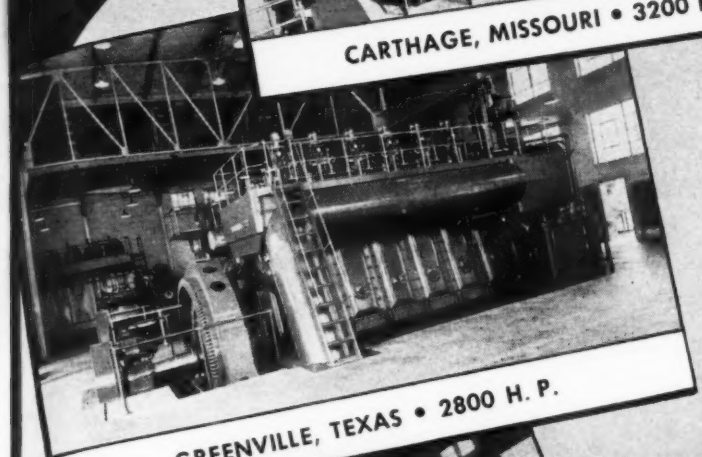
A circulating pump would probably save some water as the system would be hotter. Thus it would not be necessary to waste so much water before



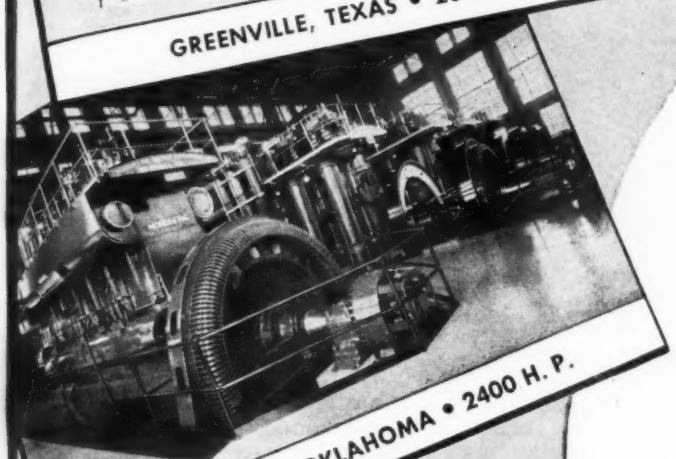
CARTHAGE, MISSOURI • 3200 H. P.



LUBBOCK, TEXAS • Two 3600 H. P.



GREENVILLE, TEXAS • 2800 H. P.



PONCA CITY, OKLAHOMA • 2400 H. P.

Repeat Orders for NORDBERG DIESELS

GRAND HAVEN, MICHIGAN • 3850 H. P.
BRYAN, OHIO • 3600 H. P.
HILLSDALE, MICHIGAN • 3600 H. P.
SIKESTON, MISSOURI • 3200 H. P.
MARQUETTE, MICHIGAN • 3000 H. P.
KEY WEST, FLORIDA • 2400 H. P.
NEODESHA, KANSAS • 1620 H. P.
ROCHELLE, ILLINOIS • 1500 H. P.

The large percentage of repeat orders received from users of Nordberg Diesel engines is evidence of the satisfactory performance of these engines. Here are some municipalities that have placed recent orders for Nordberg Diesels, *all repeat orders*. In most of the plants listed, the initial Nordberg Diesel installation was made over twenty years ago and the engine still is in regular operation. If you are in need of additional power, investigate the merits of Nordberg Diesels and their records of satisfactory performance.

NORDBERG MFG. CO.
Milwaukee 7, Wisconsin

NORDBERG MACHINERY

NORDBERG
DIESEL ENGINES

NORDBERG MACHINERY

IN SPEEDING UP the fitting of machine parts by eliminating the precision machining otherwise required, Laminum shims actually add to the certainty of uniform accuracy . . . you simply peel laminations of known precision gauge from the solid shim. Bulletin on request.

Laminum shims are cut to your specifications. For maintenance work, however, shim materials are sold through industrial distributors.

Laminated Shim Company, Incorporated

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LAMINUM

THE SOLID SHIM THAT peels FOR ADJUSTMENT

getting hot water at faucets. The reason his system gives water that is too hot for first hour is that water in tank has had time enough to get hot. During the rest of the day the heater cannot supply hot water fast enough. Also as hot water becomes cooler people use a larger proportion to amount of cold water. When hot water reaches a comfortable temperature they use all hot water.

Lombard, Ill. H D BROWN

Answers to Aug Question 2

(*Continued from page* 117)

EDITOR'S NOTE: *The following discussion on storing coal to avoid spontaneous combustion is taken from* POWER, *Sept 1942, special section, "Power Teamwork for Victory," and is repeated because of its bearing on the problem.*

Control Spontaneous Combustion in the Pile

SPONTANEOUS HEATING is the one effect of storage that must always be given attention. Coal exposed to atmosphere combines with oxygen, thus liberating heat. This is as truly "burning" as what happens in a furnace, but occurs at an extremely slow rate. It is greatest among coals of lowest rank such as lignite, subbituminous or low fixed-carbon bituminous.

The practical problem is: How can coal in the usual range of sizes be stored without spontaneous combustion? The solution lies not in ventilation but in keeping the amount of air reaching the coal surfaces to a minimum.

First step in avoiding excess air movement through a coal pile is simple but often overlooked—eliminate segregation! When coal is dropped on a conical pile from a chute or spout, coarse pieces roll or slide to outside and bottom while fines tend to stay in the line of fall. In such a pile, amount of air flow varies widely from place to place. There is always a chance that exactly the right amount of oxygen will reach some one spot and not enough heat be carried away. One bad spot will heat the whole pile and trouble will inevitably follow.

Layer piling avoids difficulties resulting from segregation by insuring mixing of fine and coarse particles. Layers, from one to several feet thick, may be deposited as a series of small piles. The coal can then be distributed by scraper or bulldozer.

Compacting carries the layer idea one step further. Coal is piled in thinner layers and each layer is "compacted" by caterpillar-tread action, by rollers,

ASBESTOS IN ACTION

● APAC, used as exterior siding on this huge administration building, combines up-to-the-minute design with maximum durability. Design and Construction by The Austin Company.

Whether your plans include remodeling or new construction, here are 3 compelling reasons why K&M "Century" APAC sheet material is the *right* material to use.

1. APAC IS VERSATILE

Furnished in 4′ x 8′ sheets 3/16″, 1/4″, 3/8″ thick, APAC is easily adaptable to outside sheathing, office panelling, partitions, elevator shaft casings, stock rooms and storage bins . . . in fact APAC has as many uses as a building has surfaces.

2. APAC IS PRACTICAL

Compounded of asbestos and portland cement, APAC is completely fire-resistant, rot-proof, vermin-proof and termite-proof. It makes a neat-looking job and will never deteriorate. Time only toughens it.

3. APAC IS ECONOMICAL

First cost is low, and APAC is so easy to cut, handle and apply that it lowers the cost of construction. Once it's on, APAC lasts indefinitely, without maintenance or protective painting.

• • •

If there's anything else you want to know about this remarkable building board, we'll be glad to give full details. Just call or send us a card.

Nature made Asbestos . . .
Keasbey & Mattison has been making it serve mankind since 1873.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

This is a Metal **PACKING RING** that has been in continuous operation for many years in a high speed Ammonia Compressor.

This is a Man using the time he used to spend replacing soft packing.

REPRESENTATIVES IN PRINCIPAL CITIES

FRANCE PACKING COMPANY
PHILADELPHIA 35, PA.

or by driving a truck across the pile. Compacting apparently depends to only a limited extent on the weight applied; most important factor is the mixing action, bringing coarse particles in close contact with fines.

Sealing represents another practical means of reducing air movement through coal piles, thus avoiding spontaneous combustion. A continuous layer of fine coal, approaching pulverized fineness, makes an airtight coating that forms an effective seal. A second covering of lump coal prevents wind-and-rain erosion of the fine-coal layer. Coatings of asphalt and ground limestone have also proved effective.

Air leaks in a sealed pile usually can be spotted by a vapor discharge, most noticeable in cold or humid weather or in the early morning. Leaks so detected may be patched with fine coal to maintain the necessary airtight covering. Special attention should be given to eliminating leaks into the pile through porous bottoms such as coarse cinders, at openings around columns, and brickwork, or at points where the pile meets the ground or containing walls.

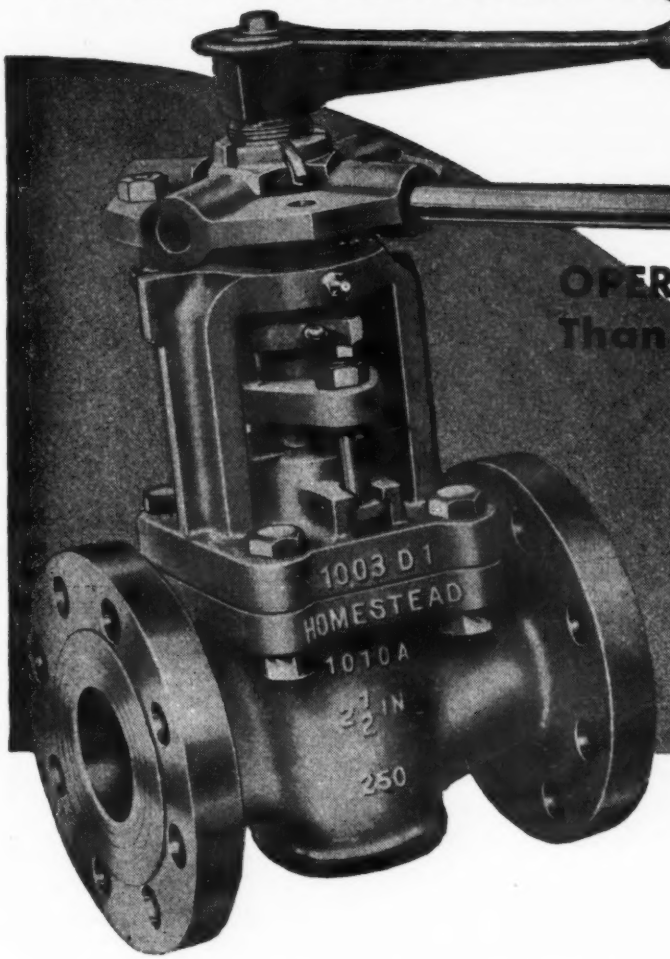
Proponents of sealing believe it to be more positive in preventing heating than compacting and more effective where coal must be stored for several years. Because sealing can be applied later, a practical solution seems to lie in trying compacting first. If trouble should develop, sealing can be applied and the trouble cured.

Nine engineers of Westinghouse Electric Corp will go to Oak Ridge, Tenn., to join the pool of scientific manpower that will work on peacetime applications of atomic power. They will carry on research at Institute of Nuclear Studies, which is being established to provide channels for cooperative research between government, universities and industrial concerns that have been involved in the atomic energy project at Oak Ridge. On one year loan for this work from the Westinghouse research laboratories are Dr Elmer B Ashcraft of chemical and metallurgical dept, Dr Sidney Siegel of magnetic dept, Dr R C Masen of electrophysics dept, Dr Jerald E Hill and Dr L P Hunter of electronics dept. Other Westinghouse engineers sent to Oak Ridge include two from E Pittsburgh works, J W Simpson of switchgear engineering dept and A H Toepfer of district engineering and service dept, and two from S Philadelphia works, N J Paladino and E F Miller of steam turbine div.

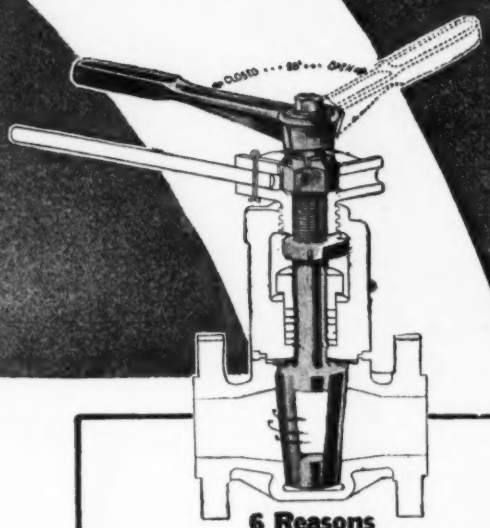
American Society for Metals made public that Dr Rufus Zimmerman, director and executive committee member, U. S. Steel Corp of Delaware, has been elected to receive the society's medal for advancement of research, 1946.

Quick Action Every Time

with Homestead Lever-Seald Valves



OPERATE 16 to 28 TIMES FASTER Than Screw-Stem Type Valves



Operation of HOMESTEAD LEVER-SEALD VALVES is quick and positive. From wide-open to fully-closed requires only a *quarter-turn* of the upper lever—and that's 16 to 28 times faster operation than the 6 to 7 full turns required by screw-stem-type valves. Not only do HOMESTEAD LEVER-SEALD VALVES operate quickly, but they are built to operate under all conditions; for built right into every valve is a powerful lever and screw device which relieves seating pressure between the plug and body just enough to overcome friction and permit easy turning. For fast, positive, labor-saving operation, they can't be beat! And the small space required by the Quarter-Turn, permits their use where other valves could not be operated.

HOMESTEAD LEVER-SEALD VALVES are made in combinations of metals and alloys to meet your service requirements, in sizes 1¼" to 10", for pressure ranges from 150 pounds to 1500 pounds. Special valves may be designed to meet your specific requirements. Write *now* for Valve Reference Book No. 38.

6 Reasons

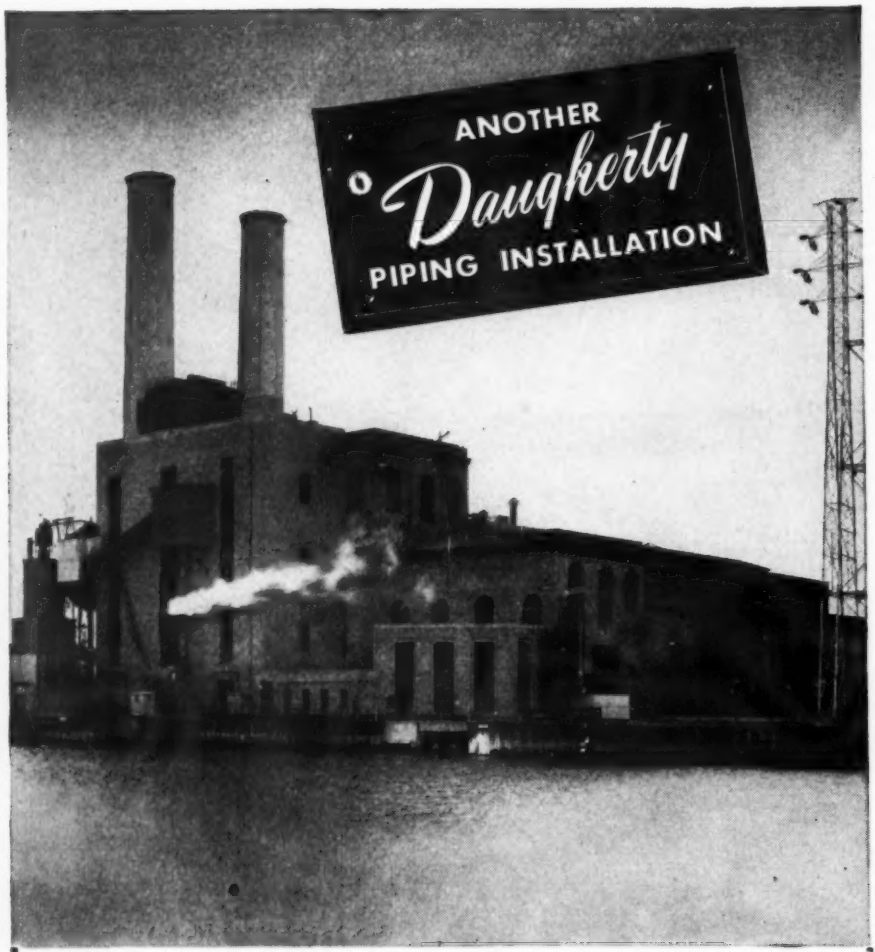
Why You Should Use Homestead LEVER-SEALD VALVES:

1. **Instant Stick-proof operation.**
2. **QUARTER-TURN FULLY OPENS OR CLOSES.**
3. **Positive seal without lubrication.**
4. **Seating surfaces always protected in both open and closed positions. Corrosion practically eliminated.**
5. **Unobstructed straight-line fluid flow.**
6. **All operating parts protected from damaging effects of service conditions and weather.**

Homestead VALVES
LEVER-SEALD

"M" Pennant with three additional gold stars—highest Maritime production award yet given to the men and women of any manufacturing company.

HOMESTEAD VALVE MFG. CO. • • • P. O. BOX 210 • • • CORAOPOLIS, PA.



Missouri Avenue Plant
Atlantic City Electric Co.
Photo taken prior to major addition now under construction.

The choice of Daugherty Company to handle the erection of piping for the *1000 degree steam installation* now being added to this well known station is further testimony to the successful experience of Daugherty Company in handling complex power and process piping.

Daugherty Company offers these facilities for power and process piping work: FABRICATION of high pressure, high temperature piping including alloy tubing. EQUIPMENT for field stress-relieving and radiographic inspection. WELDERS qualified for all classes of work. SUPERVISION by an unexcelled metallurgical, engineering and construction staff.

Daugherty Company, Inc.

502 Union National Bank Building, Youngstown 3, Ohio

PIPING CONTRACTORS for the POWER and PROCESS INDUSTRIES

New Equipment

(*Continued from page* 142)

Smoke Meter

IN PRINCIPLE, RS SMOKE METER is a photoelectric soot-density comparator. Principle of operation is based on fact that a pyrex-glass rod placed across a stream of flue gas containing oil smoke collects a soot deposit on its surface. Such a deposit collects at a rate that depends on smoke density in flue gas when rod is exposed under specified conditions. Amount of smoke deposit can be measured in terms of extent to which it will interfere with passage of a beam of light through glass rod onto a photoelectric cell.

Meter is in a metal case where a light source is mounted in form of a 15-watt lamp and photoelectric cell connected to an electric meter. Light tube supports pyrex-glass rod between lamp and photoelectric cell. A constant-voltage transformer maintains 110 v on the lamp. Two adjusting knobs are provided in the electric meter circuit. **Dept P, Refinery Supply Co, Tulsa, Okla.**

Arc-Welder

TWIN-UNIT OUTDOOR AC ARC-WELDER is in a single inclosure. Each of the two circuits in welder can be used simultaneously and independently with electrodes up to 3/16-in. dia, or combined into one circuit for heavy welding with ¼-in. electrodes. Units have a current range from 90 to 270 amp when operated singly, and 180 to 540 amp when operated in parallel.

Both welders are equipped with control that reduces open-circuit voltage to about 30 v when machine is not welding, but which makes full power available the instant arc is struck. Both halves are supplied through a single set of primary terminals, so that only one power-line circuit to unit is required. **Dept P, General Electric Co, Schenectady 5, N. Y.**

Oil Conditioner

DESIGNED TO CLEAN AND CONDITION OIL in capacities up to 47 gpm, oil conditioner removes acids, gums, varnish, moisture, carbon and dirt without destroying modern oil additives. Conditioner is built of heavy-

FOR STAMINA REQUIRED BY ENCLOSED GEAR SERVICE

SINCLAIR RUBILENE

For speed reduction units—constructed of hardened steel and with closely fitted bearings—continuous, uninterrupted operation is a hazardous *must*. Make sure that *stamina*—built into speed reducers to meet severe service demands—is fostered by a *stamina-packed* lubricant.

Such a lubricant is Sinclair RUBILENE, precision-refined for sustained mechanical efficiency. RUBILENE flows freely to all closely fitted parts, provides protecting lubricating film at points of concentrated pressure on gear teeth, resists oxidation and resultant acid, gum and sludge formation.

Protect against wear, hold operating temperatures down, avoid oxidation, sludge, and clogged oil passages with Sinclair RUBILENE. Our lubrication engineers are prepared to show you how RUBILENE is adapted to *your* operating conditions for maximum efficiency.

SINCLAIR INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

RODA

High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON

High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA

High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER

A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE

Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL

High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER

Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

LYNCO

Medium volatile, high fusion coking coal for by-product and steam use from Wyoming Co., W. Va., on Virginian Ry.

Old Kentucky

Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

CHARMCO

Unexcelled Steaming Coal from the Fire Creek Seam in Greenbrier County, W.Va., originating on the N.F.&G.R.R.

ANTHRACITE — Hazle Brook Premium . . . Raven Run

General Coal Company

123 SOUTH BROAD STREET, PHILADELPHIA 9, PA.

BRANCHES:

BLUEFIELD, W. VA. BOSTON BUFFALO CHARLOTTE, N. C.
CINCINNATI DETROIT NEW YORK NORFOLK PITTSBURGH

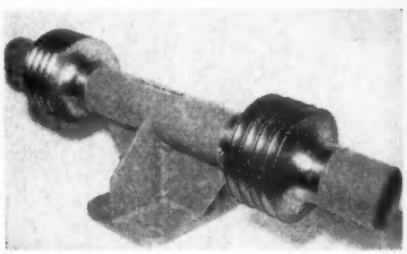
gage welded steel shell with special heavy cast-iron cover. Flanged connections are available. Oversize sump is supplied so heavy sludge conditions may be controlled without overtaxing elements.

Adequate gasket surface is furnished on cover, eliminating oil leaks. Covers are equipped with vent opening for dry-sump installations. All units are bypass equipped and designed either as full-flow-in-line or shunt conditioners. Height is 27¼ in.; dia 18½ in. Conditioner has seven bypassed valves. Lowest recommended temperature is 140 F and recommended pressure is 30 psi. **Dept P, Winslow Engrg Co, Oakland 8, Calif.**

Acid-Alkalinity Control

TRUTEST M-E-P INDICATOR is said to meet all requirements of pH control. This indicator changes from green on the alkaline side, to an intermediate gray, to a definite purple on the acid side, or vice versa. The gray tint provides a convenient warning of approaching endpoint.

One drop of this indicator is sufficient for each 25 ml of titrating volume. To titrate a 100-ml sample, only four or five drops of indicator are required. TruTest *M-E-P*, a stable, aqueous solution, contains no alcohol or other volatile liquids. It is available in 1-, 2-, 4-, 8-, 16- and 32-oz bottles. **Dept P, TruTest Laboratories, Inc, 261 S 3rd St, Philadelphia 6, Ill.**



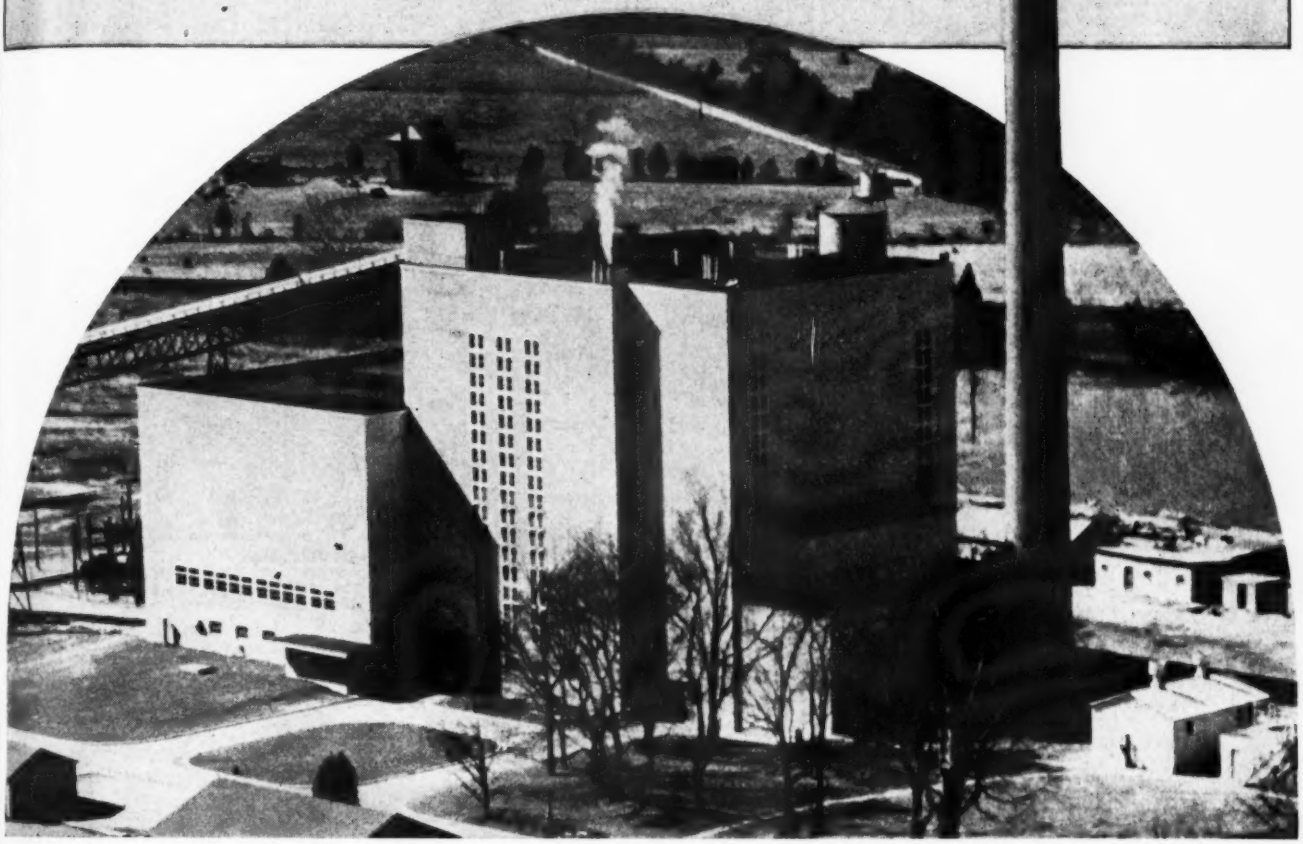
Pipe Joint and Anchor

ANCHOR JOINT serves as a rigid anchor with allowance for expansion and contraction on each side. Number of bellows on each side of anchor can be varied to suit local temperature exposure and pipe length. They are made in sizes from ½ to 24 in. and for pressures from vacuum to 1000 psi. A variety of standard fittings, such as elbows, tees, ells and Y's, can be incorporated in the joints to make a single unit. Temperatures handled range from —300 to 1600 F. Metals include stainless steel, *monel*, *Inconel* and copper. **Dept P, Magni Lastic div, Cook Electric Co, 2700 N Southport Ave, Chicago 14, Ill.**

Fuel Filter

NEW CARTRIDGE FILTER has resin-impregnated cellulose cartridges for fine filtration of diesel fuel oil, gasoline, kerosene and other petroleum distillates. Expendable filter cartridge removes particles as small as 2 microns (.00008 in.) to provide dependable purity of fuel, thus eliminating a source of damage to injectors and other equipment. Filter line consists of

TURNING DEMAND INTO SUPPLY



Chesterfield Station, Virginia Electric & Power Company, near Richmond, designed and constructed by Stone & Webster Engineering Corporation. Another new power plant for this client is now in the design stage.

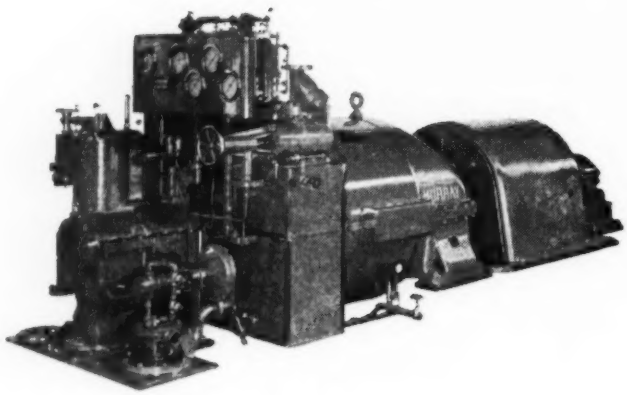
Because of the necessary curtailment of normal power plant construction during the War, the nation's utilities and industrial plants must now increase their power generating capacity to meet the growing needs of peacetime production.

New steam and electric generating facilities and plant extensions, using turbine units ranging from 1,500 to 80,000 KW and boilers ranging from 20,000 to 650,000 pounds of steam per hour, now on the design boards of Stone & Webster Engineering Corporation, will have a total capacity of 673,500 KW and 10,300,000 pounds of steam per hour.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

MURRAY
STEAM TURBINE GENERATING UNITS



Installed in 1939 in a small municipal power plant in northeastern Indiana, the above 500 KW direct connected Murray steam turbine generator set has given its owner entire satisfaction. The turbine is equipped with every device necessary for minimum of attention including steam turbine driven auxiliary oil pump. The generator and exciter may be furnished to match existing electrical equipment in your plant.

Units in this size may be furnished either direct connected or geared as preferred with performance and operation equally trouble-free.

There is a Murray representative ready to help you with design and layout information.

MURRAY *also produces*

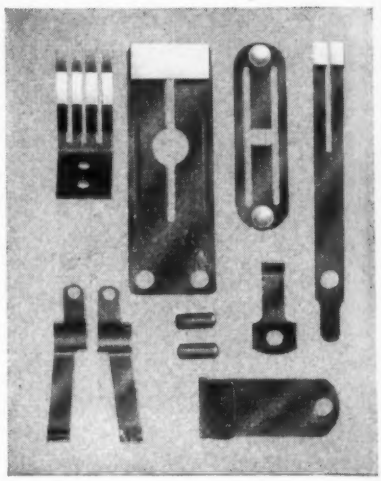
Mechanical Drive Turbines — Horizontal and Vertical Reduction Gears of the high speed type Steam Boilers

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
Builders of Steam Power Equipment for Three Quarters of a Century

several sizes with filtering areas ranging from 7 to 100 sq ft.

Inclosing tank with a bolted cover is easily kept free of sludge and filtered impurities. Cartridge filter units are easily removed and quickly replaced.

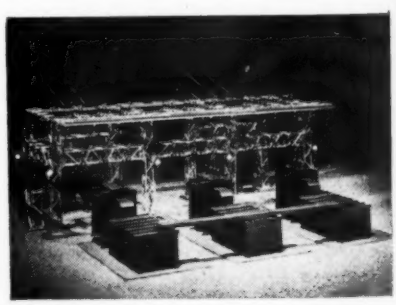
They are furnished complete with pressure gages, vent valves and removable covers. Multiple connections provide economy of space and convenience for piping. **Dept P, Bowser, Inc., Fort Wayne, Ind.**



Electrical Contact Springs

BERYLLIUM-COPPER contact springs have good physical and electrical properties. Modulus of elasticity is 18,500,000 compound, and tensile strength is about 200,000-psi compound. Electrical conductivity ranges from 25 to 32%.

Silver, silver alloys and powder-metal compositions mount easily on the springs, making complete contact assembly. The spring also finds use for contact supports where wear resistance is required. **Dept P, Gibson Electric Co, 8350 Franks-town Ave, Pittsburgh, Pa.**



Package Substations

AVAILABLE AS SINGLE UNIT in ratings up to 45,000 kva, package substations incorporate standard transforming, regulating, relaying, metering and protective equipment. Substations include, as a ready-to-assemble unit, all of the hundreds of components and parts previously obtainable on a piece-by-piece basis for installation by customer.

At present, package substations are rated from 750 to 45,000 kva (11 to 69 kv incoming and 2.4 to 13.8 kv outgoing) and in addition to factory-assembled unit substation includes: steel structure lightning

DELTABESTON*

Beats 'em All!

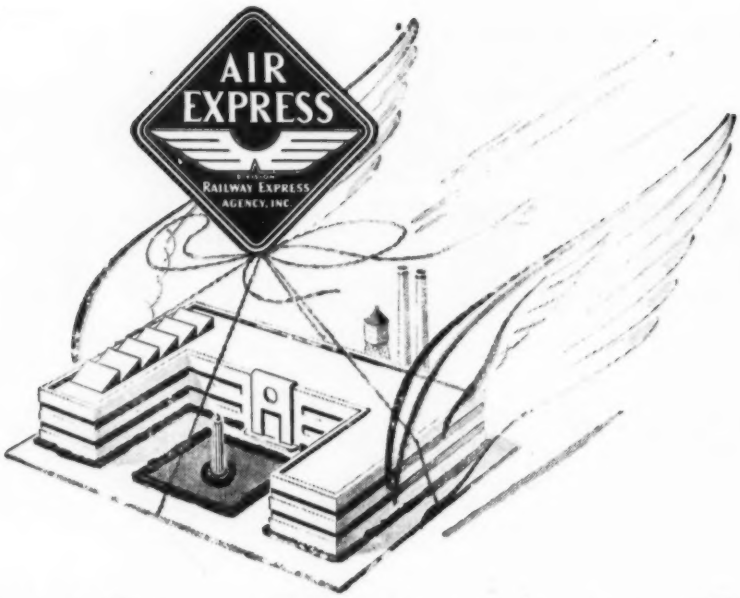
If there's a hot spot in your plant that threatens the power supply, Deltabeston can help you play safe. The unusual conditions met in steam tunnels, boiler rooms, steel plants, central stations . . . at furnaces, ladles, and soaking pits are tough on ordinary wire and cable. General Electric builds its Deltabeston cable to meet — and beat — these hazards.

There's a Deltabeston cable to protect against high ambient temperatures, another to take sudden temperature rises, many combinations in design and construction to maintain the safety factor you want. Or you may need a special cable, like the one illustrated, to meet an unusual set of conditions. This is one of many cables developed by General Electric engineers who are specialists in this field. They are ready to help in solving your wire and cable problems.

*Trade-mark Reg. U. S. Pat. Off.

For a copy of the complete Deltabeston catalog, write Section Y15-1052, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut. Deltabeston Wires and Cables are distributed by G-E Merchandise Distributors.

GENERAL ELECTRIC



Tie Your Business to the MONEY-MAKING SPEED of Air Express

NOW! THE LID IS OFF! MORE PLANES, MORE FLIGHTS — FOR EVERYBODY. PRIORITIES NO LONGER NEEDED!

How often has your business been slowed down in recent months because you didn't get something quick — maybe, because you didn't specify delivery by Air Express!

Since a day's delay in delivery can cost a lot of money, the great speed of Air Express is actually a money-making tool. It brings your farthest-away supplier within a matter of hours from your door — and at rates which have been drastically reduced — 22% since 1943. Put this service to work for your business!

Specify Air Express-a Good Business Buy

Shipments go everywhere at the speed of flight between principal U. S. towns and cities, with cost including special pick-up and delivery. Same-day delivery between many airport towns and cities. Fastest air-rail service to and from 23,000 off-airline communities in the United States. Service direct by air to and from scores of foreign countries in the world's best planes, giving the world's best service.

RATES CUT 22% SINCE 1943 (U. S. A.)					
AIR MILES	2 lbs.	5 lbs.	25 lbs.	40 lbs.	Over 40 lbs. Cents per lb.
149	$1.00	$1.00	$1.00	$1.23	3.07c
349	1.02	1.18	2.30	3.68	9.21c
549	1.07	1.42	3.84	6.14	15.35c
1049	1.17	1.98	7.68	12.28	30.70c
2349	1.45	3.53	17.65	28.24	70.61c
Over 2350	1.47	3.68	18.42	29.47	73.68c
INTERNATIONAL RATES ALSO REDUCED					

AIR EXPRESS

GETS THERE FIRST

Write Today for the Time and Rate Schedule on Air Express. It contains illuminating facts to help you solve many a shipping problem. Air Express Division, Railway Express Agency, 230 Park Avenue, New York 17, N.Y. Or ask for it at any Airline or Railway Express office.

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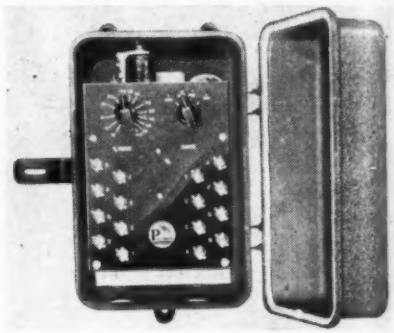
Representing the AIRLINES of the United States

arresters, high-voltage metering and relaying instrument transformers, outdoor oil circuit breakers (or fuses), disconnecting switches, station lighting, relaying as required, control cable and wiring diagram. **Dept P, General Electric Co, Schenectady 5, N. Y.**



Electronic Timer

TYPE 30HL1 is an automatic timer for intervals from 1/20th of a sec to four min. Timer controls spot welders, grinders, honing machines, drilling machines, conveyors, etc. Interval, delayed action, automatic repeat and programing, timing combinations, as well as many variations are incorporated in this one timer. They may be utilized by merely changing external connections to terminal board. In addition, a maximum time-interval selector switch provides for five time intervals.

Specifications are as follows: Supply—115 or 230 v, 50 to 60 cycles; output—two single-pole double-throw switches: relay contact rating—10 amp, 115-v ac (main output) and 1 amp, 115-v ac (auxiliary); ambient temperature—32 to 150 F; ambient relative humidity—20 to 95%; accuracy—said to be within 2%; net weight—8 lb. **Dept P, Photoswitch Inc, 77 Broadway, Cambridge 42, Mass.**

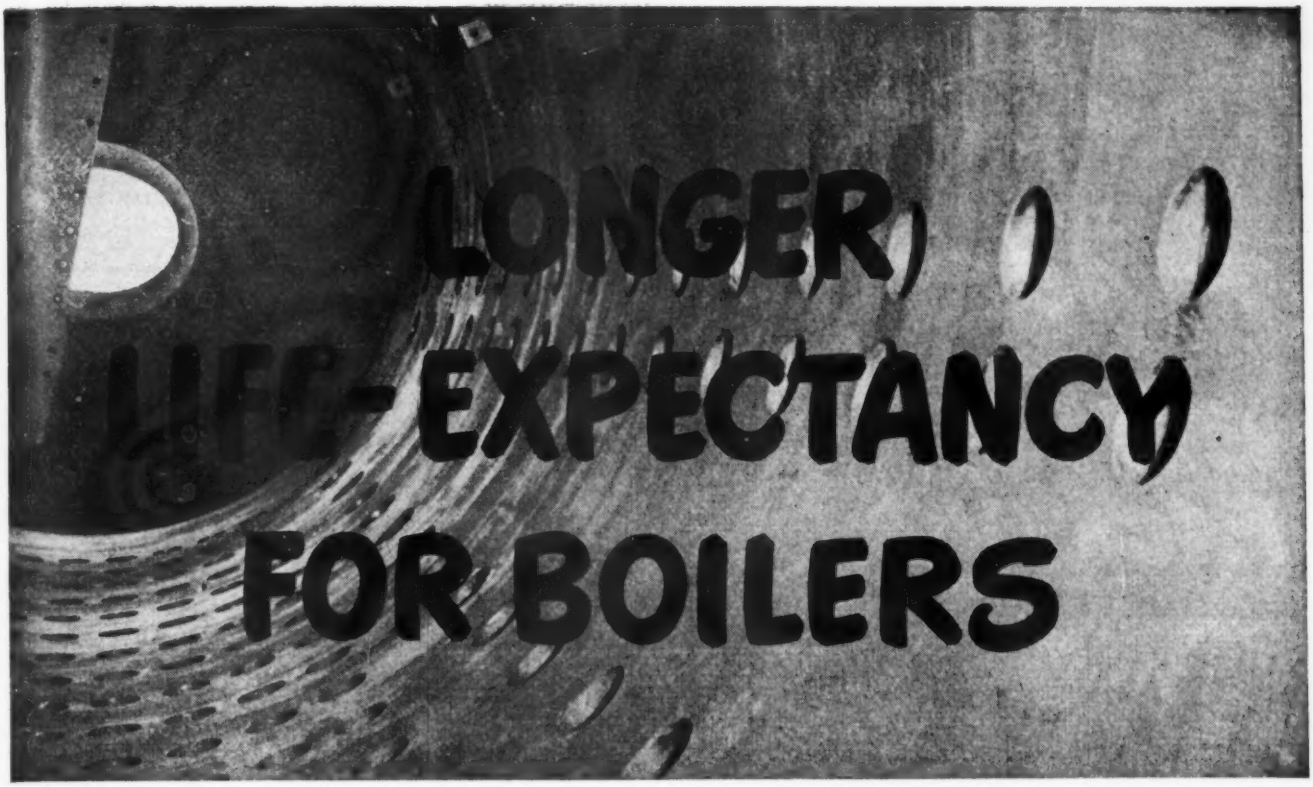
Fluorescent-Lamp Diffuser

FLUOR-O-SHIELD fluorescent-lamp accessory is for all open lamp fixtures. It is stamped from one piece of lightweight aluminum and finished in white baked enamel. It is easily installed and removed by two snap-on clamps. Present models may be installed on any standard 40-watt (48 in.) and 20-watt (24 in.) fluorescent lamps. It eliminates glare but casts no shadows. **Dept P, Camfield Mfg Co, Grand Haven, Mich.**

Fire Hose

ALL-WEATHER LINE of water-repellent mildew-resistant fire hose withstands abrasive action of gravel, cinders or rough surfaces over which it may be dragged. It also withstands extreme temperatures. Hose is flexible for easy handling at time of fire and for racking into hose body before and after service. It is flat cured.

Both hose jackets of this white *All Weather* line are water repellent. Hose jackets get a double treatment of the *All-Weather* process to make sure that all fabric is thoroughly impregnated. The



The thin coating of APEXIOR NUMBER 1 applied to the boiler interior shown above provides enduring protection in two important ways, both wholly mechanical in nature:

1. APEXIOR NUMBER 1 forms a moisture-proof seal for the metal surface, preventing contact with water and steam at all temperatures and pressures. Corrosion and embrittlement are definitely checked by this tough protective barrier.

2. APEXIOR NUMBER 1's smooth, chemically inert surface effectively retards operating deposits and prevents them from bonding tightly. Reduction in both amount and adhesiveness of deposits promotes boiler efficiency and simplifies cleaning.

These two mechanical properties of APEXIOR NUMBER 1 combine to provide longer boiler life, extended operating periods, easier and less expensive maintenance.

That such benefits are universally recognized is proved by the impressive list of railroads, steamship companies, power plants and manufacturers that find the regular use of APEXIOR NUMBER 1 a worth-while aid to efficient boiler operation. Steam turbine manufacturers apply it to shafts and rotor bodies before delivery, and these parts are benefited by its regular use. It is also applied to feedwater heaters and deaerators.

APEXIOR NUMBER 1 offers lasting, economical boiler insurance for stability, dependability and safety of operation.

APEXIOR NUMBER 3

For Metal in "Cold-Wet" Service

Where temperatures under 125°F. are encountered, APEXIOR NUMBER 3 similarly checks the corrosive action of moisture and water, fresh or salt, by completely sealing off metal-to-water contact. This special protection is advisable for such "cold-wet" surfaces as condensers, pumps, air washers, ship stern areas and every type of cold water tank, including those for drinking water.

APEXIOR coatings are easily applied with either hand-brush or power-coater. Free bulletin No. 1290 contains complete information. Use coupon below.

Two red-heat Dampney coatings are Thur-Ma-Lox Number 7 Black (1600°F.) and Thur-Ma-Lox Number 10 Aluminum (1200°F.). Properly applied, they provide lasting protection to dry metal surfaces subjected to the extreme temperatures indicated.

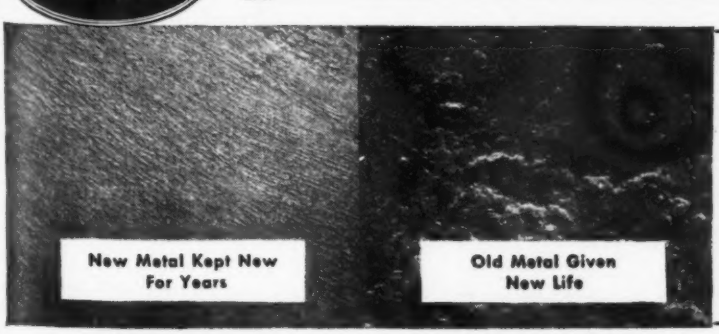
Organizations Like These Have Used APEXIOR for Years!

Louisville Gas & Electric Co.
The Proctor & Gamble Mfg. Co.
Home Oil & Refining Co.
Pillsbury Mills
Edge Moore Iron Works, Inc.
Aluminum Co. of America
Chevrolet Motor Co.
Parker Rust Proof Co.
The William Carter Co.
Lone Star Cement Corp.

APEXIOR

Keeps new metal new . . . Gives old metal new life

DAMPNEY



THE DAMPNEY COMPANY OF AMERICA
1281 River Street,
Hyde Park, Boston 36, Mass.

Please send free Bulletin 1290.

Name.....

Company.....

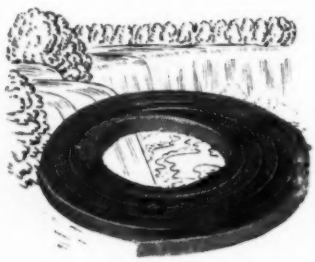
Address.....

.....

3 PLACES for a BETTER PACKING

For each of these services Belmont has created a packing with extra construction features that provide more certain sealing and longer life. And for *any* service—steam, water, oil, gas, air, acids, alkalis, ammonia—your Belmont distributor has the *right* packing.

HIGH PRESSURE STEAM RODS—Belmont's No. 30 Asbestos Packing has a unique center construction for greater resiliency and flexibility, extra takeup on the gland as the packing wears, extra "edge wear". The center block is pleated on itself, accordion-fashion, at approx. 90° with the rod.



LOW AND INTERMEDIATE STEAM RODS (also hot and cold water rods and plungers)—Belmont's No. 419 Rubber-and-Duck Packing has a hollow center which provides a point of least resistance for expansion and contraction. Friction is minimum, because the packing "breathes" toward the hole.

LOW PRESSURE TO HEAVY DUTY WATER—Belmont's No. 9 Special Hydraulic Packing has a rubber-and-duck channel which not only acts as a wiper but also protects the flax—actually two packings in one against the wearing surface. Linen thread stitching prevents displacement under gland pressure.

THERE IS A BELMONT PACKING FOR EVERY SERVICE

Belmont distributors are located in every large industrial center, ready to give you prompt delivery from local stocks.

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

IN THE BLUE-AND-ORANGE BOX

6 New Folders
Write us for new folders on Belmont Centrifugal and Rotary Pump Packings, Flax Packings, Hollow Center Packings, Oil and Gasoline Packings, Rod Packings, Sheet Packings.

THE BELMONT PACKING AND RUBBER CO.

Butler and Sepviva Streets
Philadelphia 37, Pa.

Alaseptic treatment (mildew inhibiting) is applied the same time new hose receives *All-Weather* treatment. The process combines a water repellent and a mildew inhibitor in same operation.

All-Weather Cabledge hose is the feature brand. Hose edges are strongly reinforced with special high-tension cable-cord yarns. **Dept P, American-LaFrance-Foamite Corp, Elmira, N. Y.**

Safety Seal Ring

SAFETY SEAL RING protects metal ring gaskets against corrosion and acts as an additional sealing agent. Synthetic rubber ring, resistant to practically all acids and distillates, withstands temperatures up to 300 F. It is designed with a bead on both inside and outside circumferences. Bead abutting metal ring is larger of the two, and when flanges are drawn tight, is compressed against metal ring, sealing leaks that might exist because of distortion, denting, nicks or other metal-ring irregularities. In addition to compression by flanges, pressure "flows" bead against metal gasket. Smaller bead prevents ring from buckling while being placed in position and retards turbulence between flanges.

Ring is made for inside and outside metal ring gasket. It compensates for leaks caused by loosened connections as a result of vibrations or elongation of studs. **Dept P, J G Long, Houston, Tex.**

Portable Pyrometer

NEW COMBINATION of detachable portable pyrometer and permanently installed thermocouples provides dependable temperature measurements under severe operating conditions, such as excessive vibration, dust and dirt, fumes, etc. This pyrometer equipment is especially adapted to portable engine installations. **Dept P, Illinois Testing Laboratories, Inc, 420 N La Salle St, Chicago 10, Ill.**

Carbide-Tipped Drills

IMPROVED LINE of Carboloy masonry drills now includes 15 sizes, ranging from 3/16- to 1½-in. nominal dia. Drill design features a solid round shank without flutes, which gives great strength and maximum support to cemented, carbide cutting tip.

Drills come individually packaged, together with complete operating and serv-

(*Continued on page* 176)

Here's Permanent Proof of *Controlled Quality*

This Exclusive Heat Code Symbol Means a Modern Metallurgical Laboratory for Every User of LADISH FORGED STEEL FITTINGS

What if you were offered the services of one of industry's most modern and extensive metallurgical laboratories at no expense to you?

Well that's exactly what the exclusive heat code identification represents to each user of Ladish Forged Steel Fittings. More than a symbol of uniformity, high quality and reliability, it is a pledge to supply upon request a certified analysis of the exact chemical and physical properties of the specific melt of steel from which each fitting has been forged.

And you can be sure that the willingness to supply this data stems from the certainty that the steel used in every Ladish Forged Steel Fitting meets the high minimum standards which are written into all Ladish specifications.

The heat code symbol—permanent proof of Controlled Quality—provides each Ladish customer with data they could obtain only through extensive tests and inspections. This exclusive service is yours—simply by specifying Ladish Forged Steel Fittings for your piping installations.

STOCKED AND SOLD BY AUTHORIZED LADISH DISTRIBUTORS IN ALL PRINCIPAL CITIES

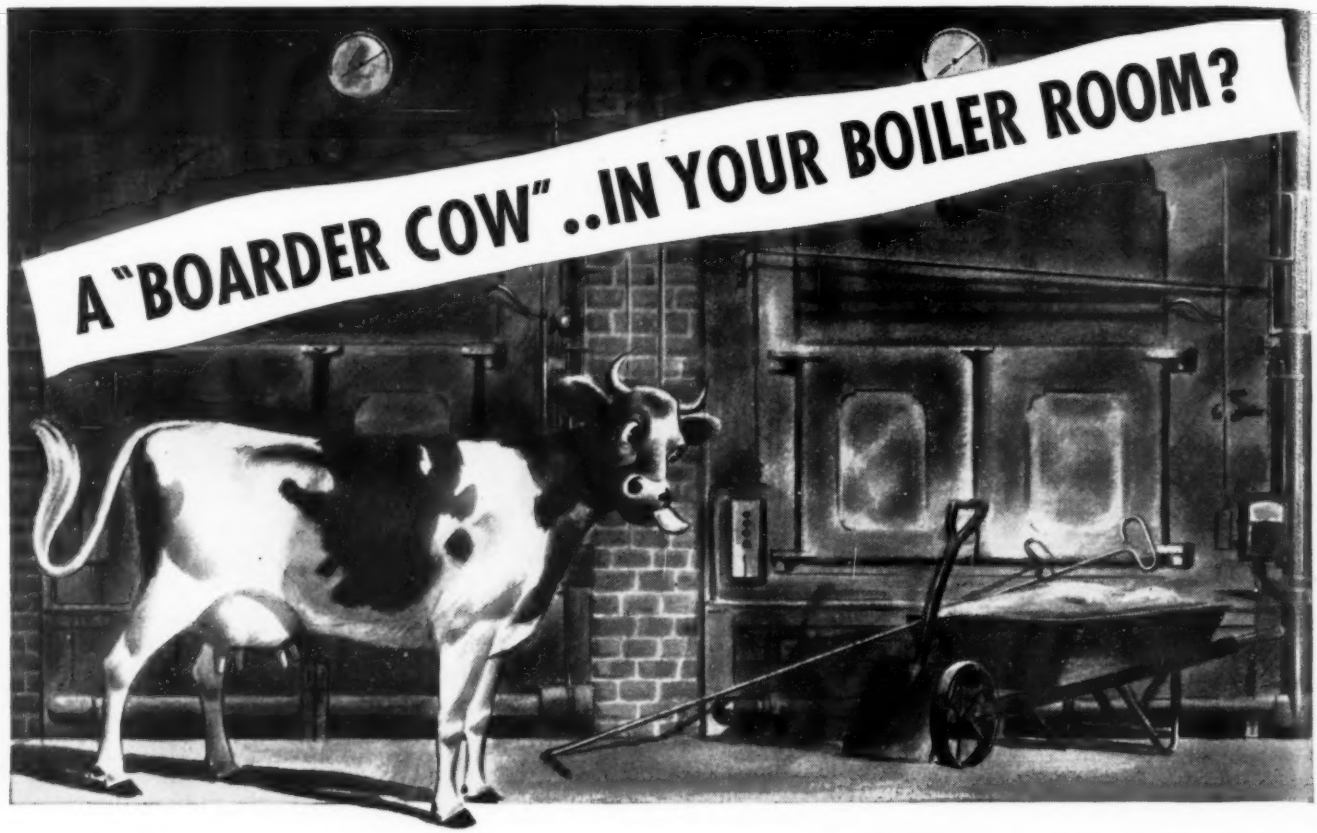
Send for this valuable engineering and technical data book. Ask for Ladish Forged Steel Fittings Catalog, Volume II.

FITTINGS DIVISION

LADISH DROP FORGE CO.

CUDAHY • WISCONSIN (MILWAUKEE SUBURB)

District Offices: NEW YORK • BUFFALO • PITTSBURGH • CLEVELAND • CHICAGO • ST. LOUIS • HOUSTON • NEW ORLEANS • LOS ANGELES



If you are familiar with dairy farming you know the significance of the expression "boarder cow" — the "critter" that feeds prodigiously but yields only a bare minimum of milk.

Some steam boilers are like boarder cows — eating enormous amounts of fuel for minimum yields of steam.

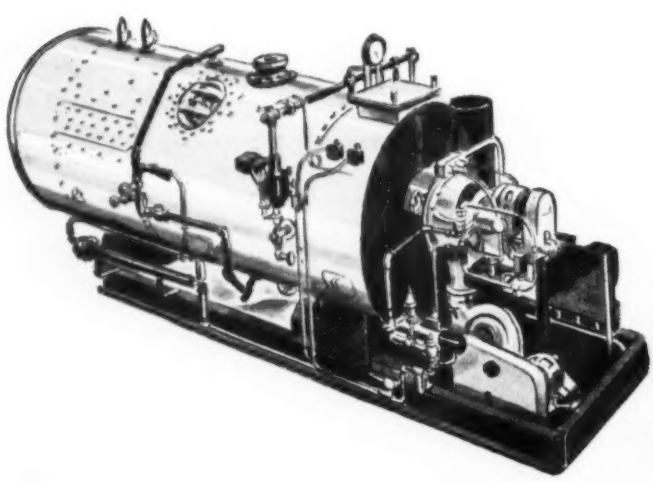
Check your operating budget to realize the money-loss involved in faulty steam generating. It's a needless loss, too, for steam generating costs can be substantially cut — service vastly improved.

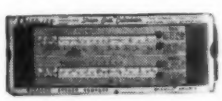
A custom-planned, application-engineered Cleaver-Brooks Steam Generator installation has made lower fuel and steam costs a reality in scores of plants. Here are some of the reasons:

- A steam plant tailored for your job. Cleaver-Brooks analyzes your load conditions, space and equipment arrangements, future growth needs, puts unit into initial operation, instructs as to operation, care, maintenance.
- Designed for utmost convenience of operator—all controls may be operated from front of boiler. A factory engineer puts unit into initial operation, and trains your employees in operation, care, maintenance.
- One source and one responsibility for the complete generator—Cleaver-Brooks factory-finished and tested—a fully "packaged" unit meeting all code requirements.
- Fast installation. No special foundation needed. Within 24 hours after arrival, your Cleaver-Brooks Steam Generator can be in operation.
- No smoke-stack required; simple roof-high vent exhausts combustion gases.
- Saves space, uses less plant area, fits into low head-room locations.
- Oil-firing eliminates smoke, ashes, clinkers, messy boiler-room conditions.
- Low operating costs; unsurpassed guarantee:—80% thermal efficiency from full load down to 30% of its rating; 13% CO_2 gases; stack temperature not to exceed 125° F. above standard steam temperature.
- Quick steaming—for any emergency or fluctuating loads—through high heat transfer with Cleaver-Brooks 4-pass down-draft construction and integral oil-burner.
- Full-size range is available—22 models in sizes from 15 to 500 h.p., at steam pressures from 15 to 200 lbs. p.s.i. Write for bulletin and complete information.

CLEAVER-BROOKS COMPANY

332 E. KEEFE AVENUE MILWAUKEE 12, WISCONSIN

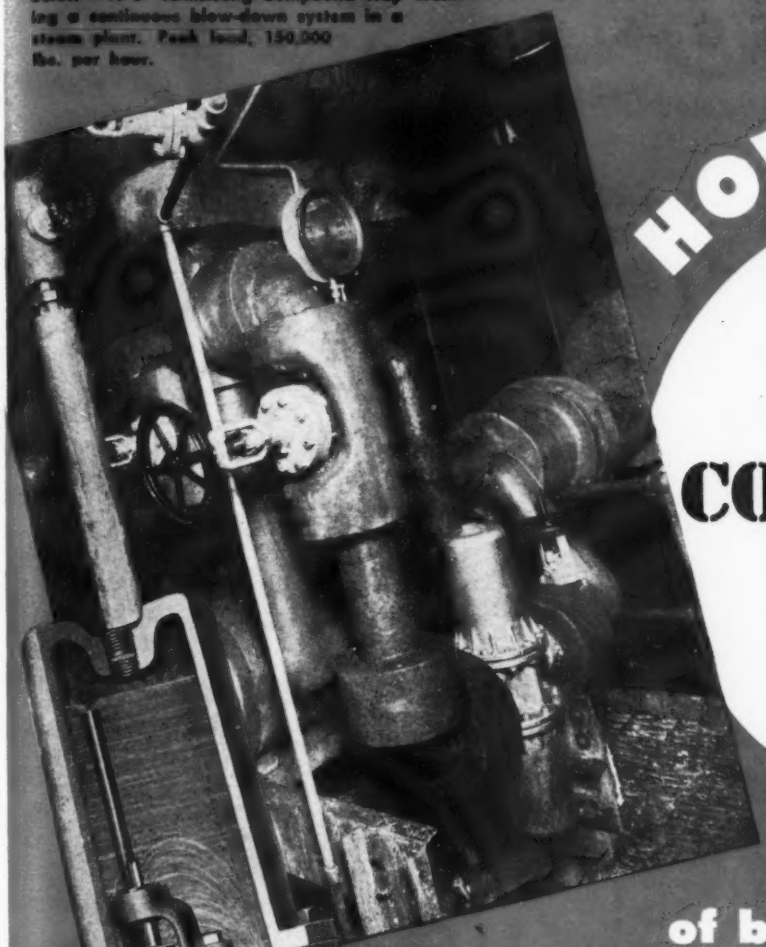




Cleaver-Brooks
STEAM GENERATORS

WRITE on your business letterhead for the Free Steam Cost-Calculator — a ready-reference slide rule showing the comparative steam costs when using oil or coal as fuel.

Below — A 3" Armstrong Compound Trap draining a continuous blow-down system in a steam plant. Peak load, 150,000 lbs. per hour.



HOW TO TRAP BIG CONDENSATE LOADS

for quick removal of both air and water —

. . . use an ARMSTRONG COMPOUND TRAP

The Armstrong Compound Trap is an ingenious development which has met with wide favor in handling big condensate loads such as may be produced by steam purifiers, separators, flash tanks, heat exchangers, evaporators, and other big units. The design of the trap is very simple — a standard trap mechanism is used as a pilot valve to open a large discharge port. You get all of Armstrong's outstanding advantages: *self-scrubbing . . . non-airbinding . . . big air-handling capacity . . . long life parts . . . no springs . . . complete satisfaction.* Ask for interesting descriptive literature. Engineering recommendations on request.

ARMSTRONG COMPOUND TRAPS are built in four sizes . . . 1", 2", 3", and 6" pipe size connections . . . capacities up to 300,000 lbs. of water per hour . . . operating pressures up to 600 p.s.i.g.

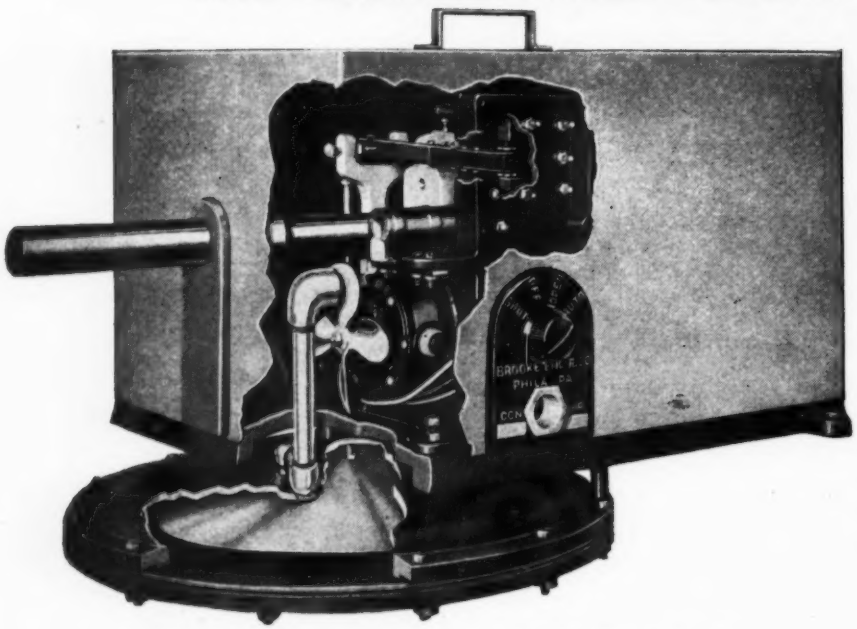
ARMSTRONG MACHINE WORKS
812 MAPLE STREET • THREE RIVERS, MICHIGAN

ARMSTRONG "INVERTED BUCKET" STEAM TRAP

ARMSTRONG *Inverted Bucket* **STEAM TRAPS**

Over a Million in Use . . . For Power . . . Process . . . Heating

ARE YOU WASTING FUEL BY . . . . . OPERATING YOUR STOP-START BURNER OR STOKER WITH THE DAMPER WIDE OPEN?



BIG INCREASE IN FUEL SAVINGS!

Why not stop the excess heat going out your stack? Brooke AUTOMATIC FURNACE regulators will throttle the boiler damper to maintain ideal combustion conditions while the burner is ON, and run the damper shut to bottle in the heat while the burner is OFF. This is a *sequence* control. Damper must be open before fuel feed starts.

Sequence is entirely automatic as follows:

★ 1. Pressure stat runs the damper regulator (type JFC) to wide open position.

★ 2. Switch on shaft of regulator closes when damper is wide open. This starts the burner and puts the regulator on, "AUTO." to maintain MINIMUM DRAFT. Damper closes to correct position to maintain minimum draft.

★ 3. Steam pressure rises and shuts off the burner. Regulator runs to shut position automatically.

★ Note that damper is automatically shut whenever burner or stoker is not in operation.

Brooke Engineers are specialists in modern automatic high-accuracy boiler and furnace controls, and are available to advise you on your draft and control problems.

Write us today for detailed bulletin containing useful information.

BROOKE ENGINEERING CO., INC.

4517 Wayne Avenue · Philadelphia, Pa.

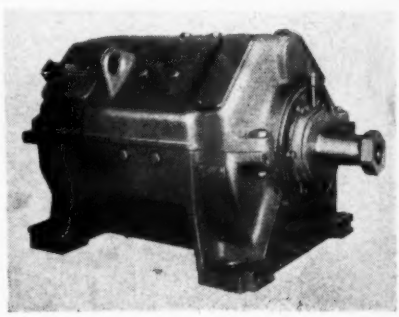
MANUFACTURERS OF THE FIRST SUCCESSFUL ELECTRIC EYE SYSTEM OF COMBUSTION CONTROL

ice instructions. Six most commonly used sizes are available in a sturdy canvas kit, the set comprising 3/16-, 1/4-, 5/16-, 3/8-, 1/2- and 5/8-in. nominal diameter drills.

These drills may be applied in any rotary portable drill or hand brace, eliminating hammer-and-chisel work. They may also be used in drill presses. The drills cut cleanly so that holes can be spaced closely together without breakthrough. **Dept P, Carboloy Co, Detroit, Mich.**

Square-Frame Welder

MODEL WA-300 SQUARE-FRAME WELDER provides a welding service range from 60 to 375 amp. This model retains compact design found in smaller square frame models, including 2-part construction, single-heat control, visual current calibration and adaptability to parallel operation where high amperage is desired. Outstanding features include weatherproof construction, polarity reversing switch and removable stator, plus overload protection both for contacts and for new low-voltage magnetic starter. **Dept P, Harnischfeger Corp, Milwaukee, Wis.**



Electric Mill Motors

TYPE *MD*-600 DC ARMORED MILL MOTORS will ultimately replace GE *MD*6400 mill motors. Featuring increased horsepower in small space and retaining sturdy construction of *MD*-400 series, they have been designed in ratings from 5 to 200 hp.

Redesigned internal ventilation system carries heat from armature more efficiently for rapid dissipation. Improved electrical design of armatures and careful proportioning of armature slots and commutating poles provide increased overload capacity. For ground insulation, high-temperature silicone resin varnish is applied as a binder for mica on armature coils. Wide band of sparkless commutation beyond 200% load allows motor to be used under severe operating conditions. **Dept P, General Electric Co, Schenectady 5, N. Y.**

Lube-Oil Filter

MICRO-FILTRATION OF OIL by triple trapping is the feature of a new filter, called *Engine-Life*. It is said to thoroughly cleanse contaminated oil, removing all damaging foreign substances without altering or reducing additives present in many modern lubricants. Improved filter is made in different cartridge sizes to fit all cases. Long-threaded lint-free textiles compose the fil-

TH

THE FIRST WAS SO SATISFACTORY
THAT MUSCATINE, IOWA

Ordered a Second

DETROIT ROTOGRATE STOKER

First Detroit RotoGrate Stoker installation with 100,000-pound capacity unit at Muscatine, Iowa, Water and Electric Plant.

●

In 1944, the Muscatine, Iowa, Municipal Water and Electric Plant installed a Detroit RotoGrate Stoker. This first unit has a capacity of 100,000 pounds of steam per hour and handles a widely fluctuating load. A second Detroit RotoGrate Stoker for a 160,000 pounds per hour unit has now been ordered. Midwestern coal of approximately 10,500 BTU is used.

Because the Detroit RotoGrate Stoker successfully burns a wide variety of fuels its popularity is rapidly increasing.

Write for bulletin.

DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

District Offices in Principal Cities • Works at Monroe, Michigan

Prevent and Eliminate

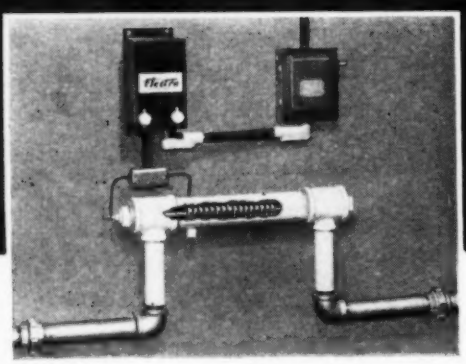
SCALE

with

ELECTRO

WATER CONDITIONERS

A simple installation (shown at the right) between the pre-heater and injector pump or between injector pump and the boilers is all that is required.



Multiple installations and repeated orders from—

- Steel Mills
- Steel Fabricators
- Paper Mills
- Food Processors
- Rubber Plants
- Public Buildings

...and other manufacturing industries using over

300,000 HP.

prove that Electro will help you solve your boiler water problems.

Prevents lime deposits and scale formation. It also prevents corrosion, foaming, priming and bumping. Embrittlement and cracking are thus alleviated. Pitting is unknown after an Electro installation.

Eliminates the use of boiler compounds and harmful chemicals with their periodic cleaning shutdowns. Algae and foreign growths are stopped immediately. A semi-monthly cleaning takes only fifteen or twenty minutes.

Reduces fuel costs and maintenance expense. It reduces to a minimum the number and the length of shutdowns for cleaning boilers and lines. Reduces depreciation of lines, equipment, etc.

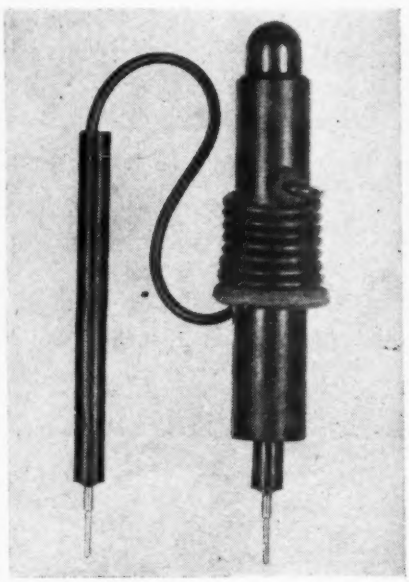
STOMAC ENGINEERING CO. Inc.

2012 W. 25th St. Cleveland 13, Ohio.

Branch Offices: 726 Empire Building, Milwaukee 3, Wisconsin; 506 S. Wabash Ave., Chicago, Illinois

tering media, scientifically compacted to uniform density.

Laminated construction and outside-to-inside flow result in multi-element filtering effectiveness of maximum area for any given size case. As fluid velocity is the same throughout filtering media, there is uniform deposition of abrasives, contaminants, etc, with no tendency to block or clog one area from another. A strong, flexible circular seal is built in as an integral part of element. Cylindrical perforated core is made from extra-heavy noncorroding alloy steel. **Dept P, C M Fuller Co, 2043 Santa Fe Ave, Los Angeles 21, Calif.**



Pocket Test Lamp

A COMBINATION TEST LAMP and voltage indicator, *Hi Tester* is an easy-to-carry pocket instrument. Equipped with a filament lamp (not neon) it has only one test lead, which prevents shorting-out resistor.

It locates grounds, open circuits or blown fuses on either ac or dc systems. It indicates approximate voltage for tracing control circuits. Gives definite signals in brightly lighted as well as dark places. No fuses are required for safety. Both lamp and test lead are easily renewed. **Dept P, Holub Industries, Inc, Sycamore, Ill.**

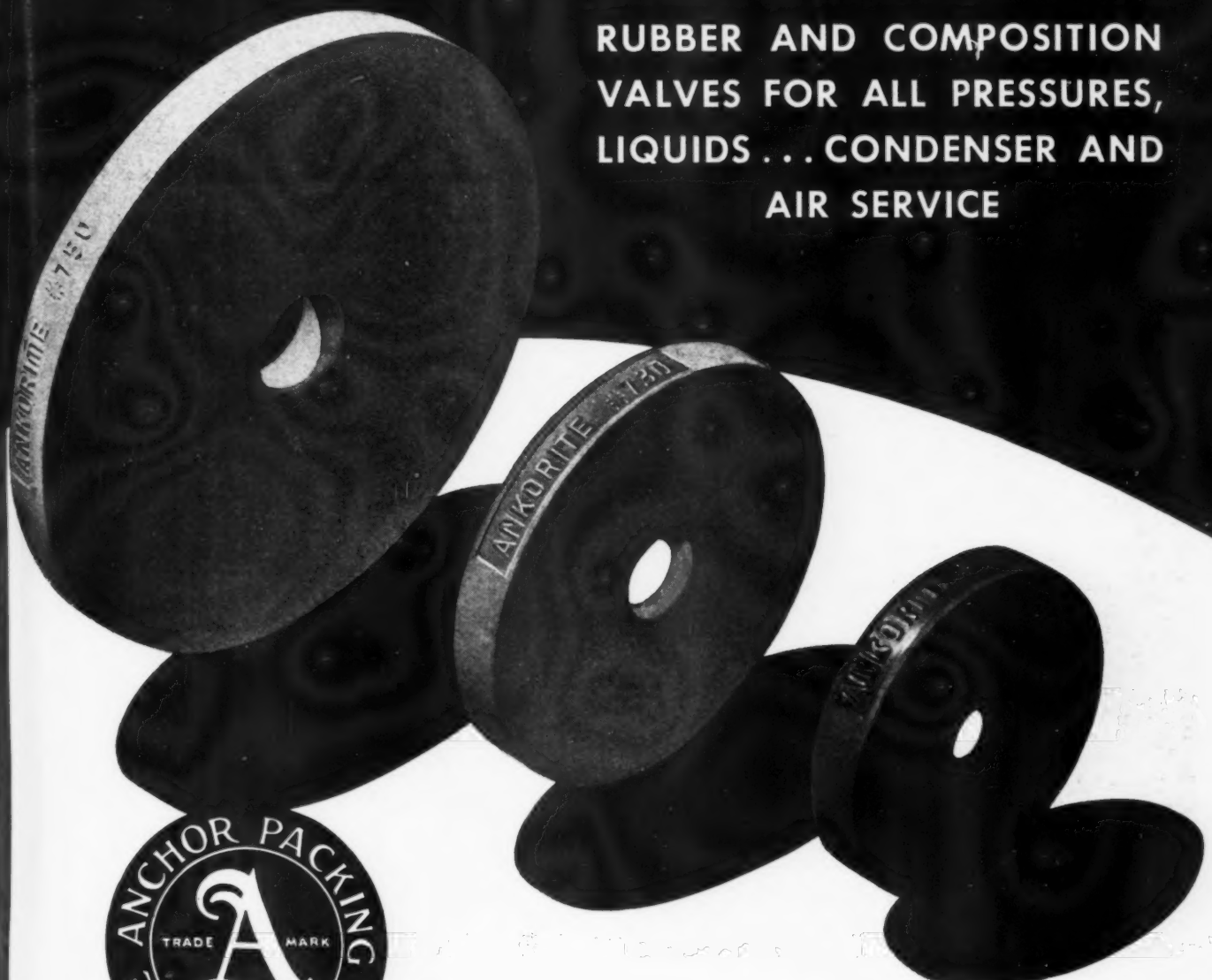
Panel Meters

LINE OF DC MOVING-VANE AMMETERS and voltmeters have long, easy-to-read scales. Pointer oscillation is reduced to a minimum by the new high-torque lightweight *USG* movement. Sharply defined numerals and graduations are lithographed on warp-proof color-fast metal dials that have a scale length of 80 deg of arc on the center zero scale and 60 deg of arc on the zero off-center scales.

The extra-long 80-deg scale is claimed to lead to great accuracy of these ammeters. This feature combined with pointer stability makes these ammeters valuable for installation on equipment where severe vibration is a usual condition. They are

ANCHOR PUMP VALVES

RUBBER AND COMPOSITION VALVES FOR ALL PRESSURES, LIQUIDS . . . CONDENSER AND AIR SERVICE



THE ANCHOR PACKING CO. TRADE A MARK

We are equipped with molds for the manufacture of every size of pump valve.

For many years we have supplied valves to the leading Pump Manufacturers, also to Mine Operations, Railroads, Industrial Plants and Marine Equipment.

Our experience gained in the compounding of materials suitable for various valve conditions enables us to meet all requirements of service.

Write today for detailed data on the advantages offered by ANCHOR PUMP VALVES.

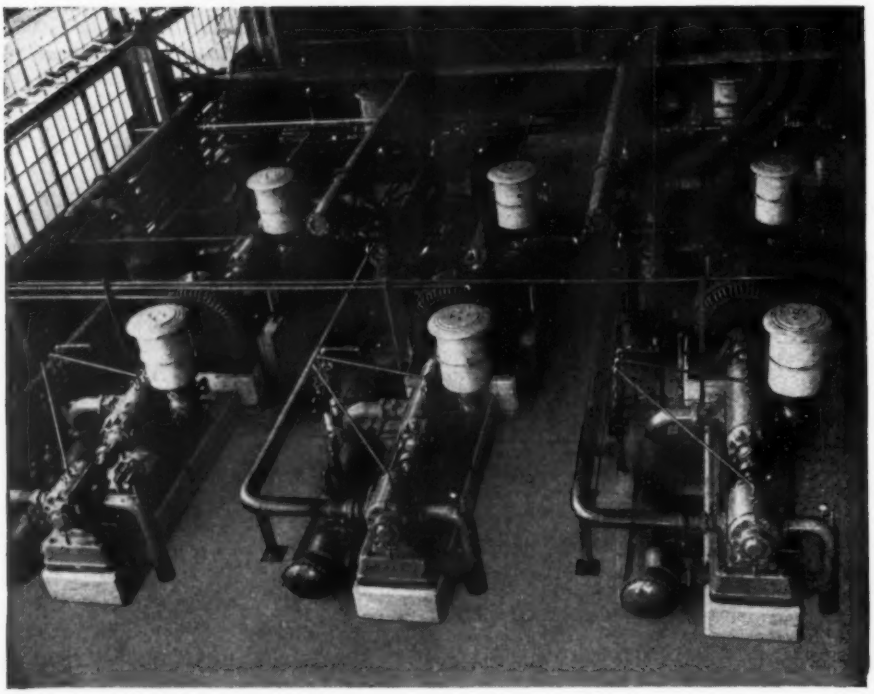
THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

BRANCH OFFICES

Baltimore, Maryland . . Boston, Massachusetts . . Buffalo, New York . . Cleveland, Ohio . . Columbus, Ohio . . Chicago, Illinois . . . Cincinnati, Ohio . . . Detroit, Michigan . . . Houston, Texas . . Kansas City, Missouri . . . Los Angeles, California . . Montreal, Canada . . Milwaukee, Wisconsin . . New Orleans, Louisiana . . New York, New York . . Philadelphia, Pennsylvania . . Pittsburgh, Pennsylvania . . Portland, Oregon . . . San Francisco, California . . Seattle, Washington . . St. Louis, Missouri . . . Tulsa, Oklahoma . . . Wilmington, California



70 Fuller Rotaries Installed Since 1938

In June 1938, one of the larger manufacturing companies of this country purchased its first Fuller Rotary Compressor. Satisfactory performance of the initial installation has led to many more installations being made in the original plant and plants of affiliated companies. Today 70 Fuller Rotaries are in operation in the various plants.

The machines installed range from single-stage, 40-lb. pressure, to the duplex two-stage, 3300 c.f.m., 125-lb. pressure, three of which are shown in the foreground of photograph above.

These machines will serve them for many years to come. They're built for long life, only three moving parts: rotor — bearings — blades. Also of prime importance — due to their design and construction, *Fullers will continue to maintain original capacities for the life of the machine.*

Write for Bulletin C-5. We'll gladly send you a copy.

FULLER COMPANY
CATASAUQUA, PENNSYLVANIA

Chicago 3 - 1144 Marquette Bldg.
San Francisco 4 - 421 Chancery Bldg.
Washington 5, D. C. - 618 Colorado Bldg.

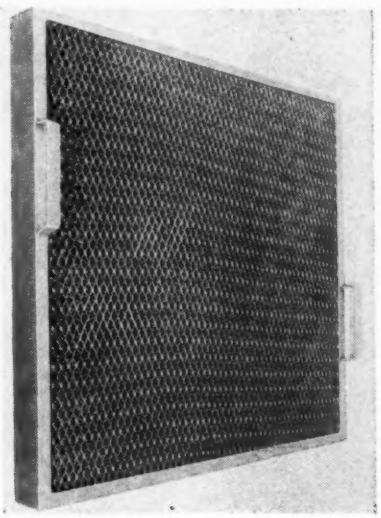
C-131

FULLER
PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

ideally suited for marine, automotive, tractor and diesel-engine panels, also for rate-of-charge indicators on battery chargers. **Dept P, U. S. Gauge Div, American Machine & Metals, Inc, Sellersville, Pennsylvania.**

Gas-Meter Valves

MORGANITE NO-DRAG VALVES are constructed of carbon graphite. Chief advantages of these valves, according to maker, are the following: (1) self-lubrication (2) immunity to chemical attack (3) dimensional stability (4) quiet operation. *No-Drag* valves are supplied in slide or circular-motion models for all makes of meters. **Dept P, Morganite, Inc, 3304 48th Ave, Long Island City 1, N. Y.**



Air Filter

ALL-METAL, cleanable air filter handles 1200 cfm through a 20x20-in. panel at an approach velocity of 432 fpm. Layers of expanded metal, so placed as to develop a turbulent action of air within the filter, create a wiping action against filter surfaces. *Agitair FM* relies on frames of cold-rolled steel and arc-welded construction to withstand any mechanical abuse from cleaning the all-metal filter media. **Dept P, Air Devices, Inc, 17 E 42nd St, New York 17, N. Y.**

Valve Diaphragm Motor

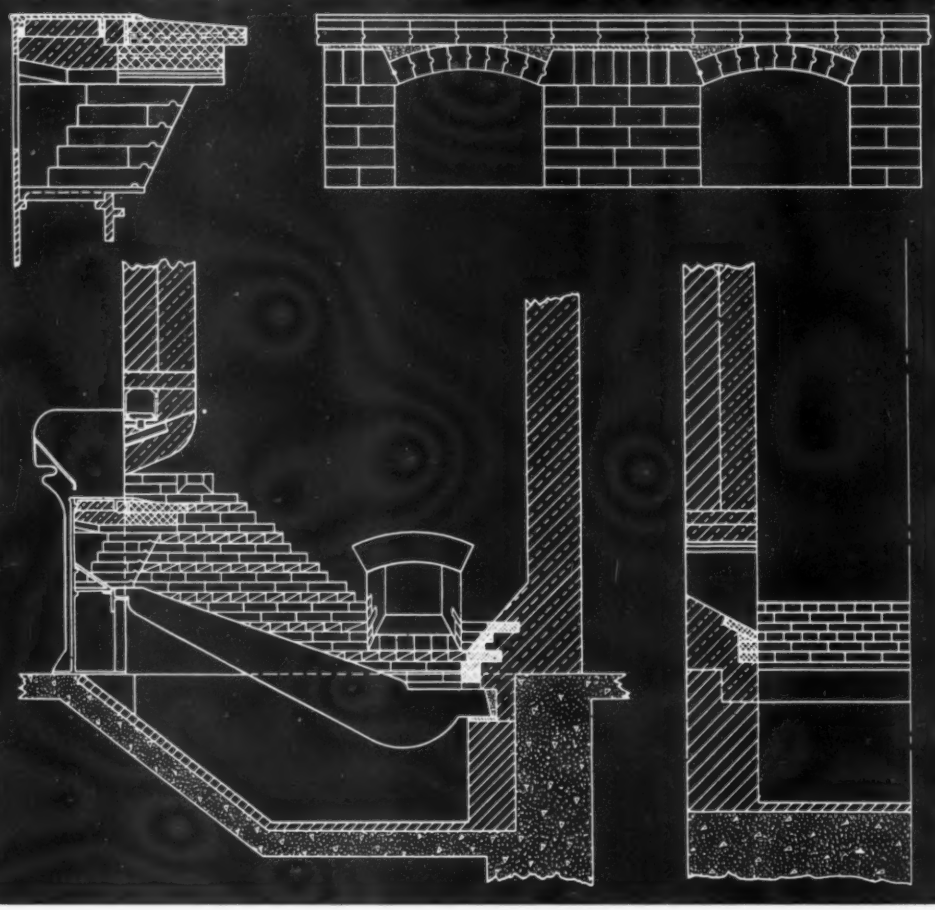
SEALING DIAPHRAGM CONSTRUCTION enables reverse action without use of a stuffing box. Other features include large diaphragm area; long-stroke action; inclosed spring, separate from pressure chamber; linear travel relationship to air-pressure change; interchangeable with Fisher's direct-acting Type-T top.

Intended application of this diaphragm motor is for pneumatic-operated control valves where push-down is desirable to close inner valve, yet operation requires valve air opened, spring closed (closes on operating medium failure). For field and general service, this top allows integral mounting of Fisher's *Wizard Pressure* pilot or time-cycle intermitter directly on valve.

WALL BRICK DATA

HUBER STOKER

This lining *Increases Capacity* *Lowers Cost*



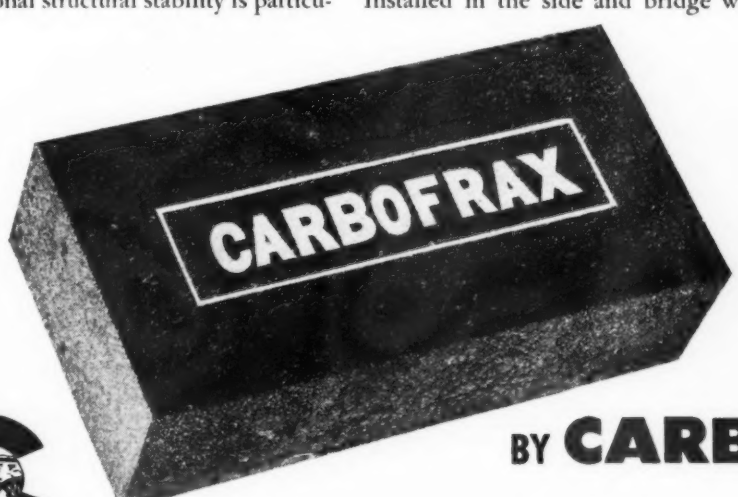
Overall efficiency is greatly improved when Huber stoker fired boiler furnaces are equipped with CARBOFRAX silicon carbide linings. A typical installation, which may be changed to meet individual plant conditions, is shown by the illustration.

Constructed of rugged interlocking CARBOFRAX shapes, the coking shelf provides longer trouble-free service. Its exceptional structural stability is particularly resistant to the mechanical abuse encountered. The abrasive action of the fuel is successfully resisted by the hard, dense surface of the CARBOFRAX shelf tile. They also eliminate carbon penetration with its attendant difficulties. Softening and subsequent sagging of the coking shelf is avoided by the high refractoriness characterisric of the CARBOFRAX shapes.

Installed in the side and bridge walls, CARBOFRAX brick prevent large clinker formations. As these brick do not soften, clinkers have no opportunity to become embedded. The walls remain relatively clean. Fuel burns more effectively over the entire grate area resulting in more steam production. Stoker operation is improved—is much more efficient.

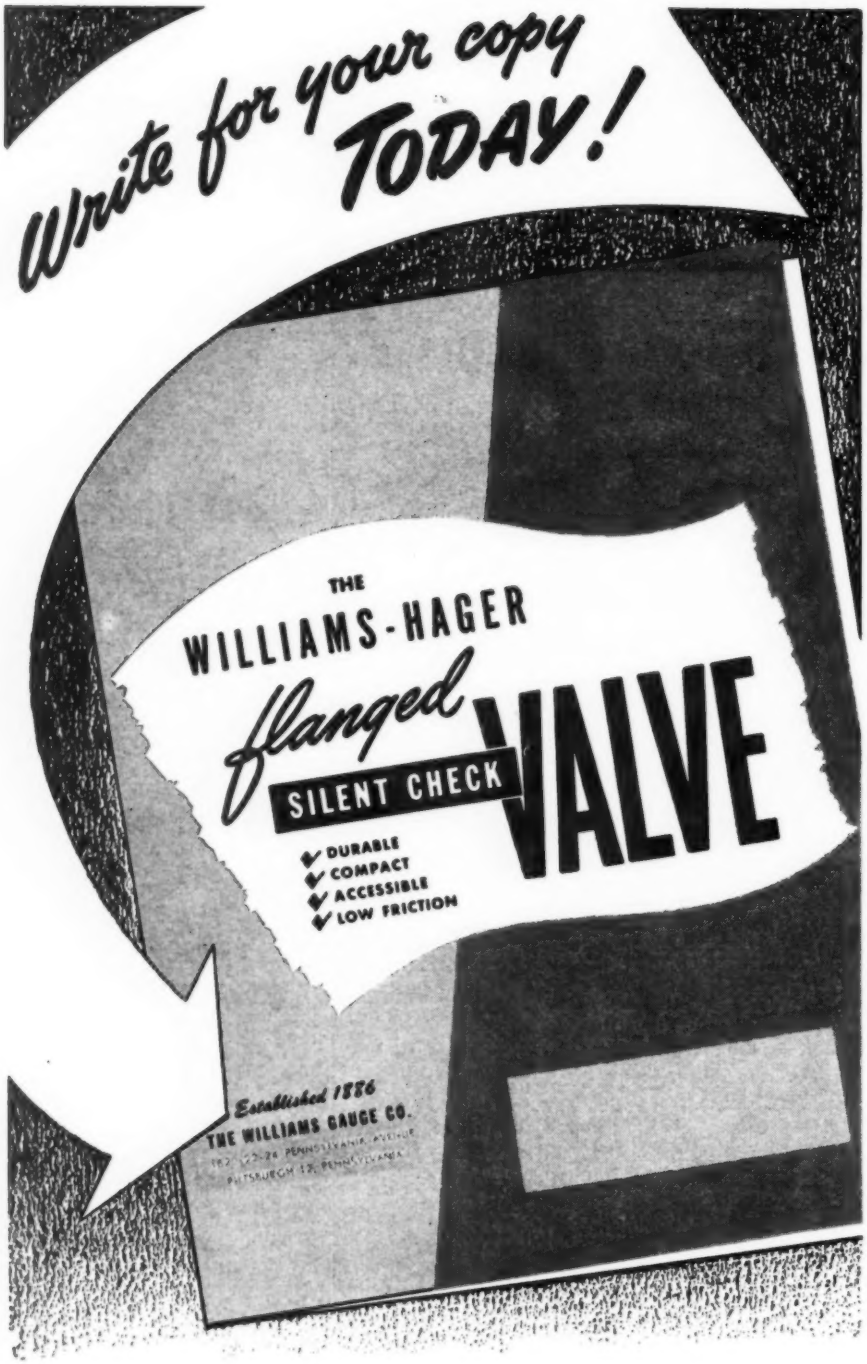
With the longer lasting CARBOFRAX lining maintenance is negligible. Repair and replacement costs are slashed. Outages for setting repair are rare. Continuous on-line service with increased steam output is assured.

These and many additional advantages make the selection and installation of a CARBOFRAX lining a "must" in engineering for greater production and economy. That is why it pays to get all the technical facts. They are clearly illustrated in our booklet on CARBOFRAX settings. For your copy simply write Dept. G-106, The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.



BY **CARBORUNDUM**
TRADE MARK

"Carborundum" and "Carbofrax" are registered trademarks which indicate manufacture by The Carborundum Company



HAS "WATER HAMMER" BEEN A PROBLEM IN YOUR PLANT? This new bulletin completely describes the Williams-Hager Flanged Silent Check Valve—designed to meet this problem and one of the most important developments in Check Valve design. Thoroughly tested in every industry, for every type of service—with many installations serving trouble-free for upwards of 18 years.

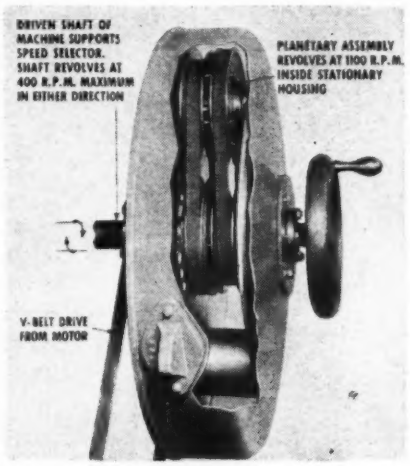
THE WILLIAMS *Gauge* COMPANY

2055 PENNSYLVANIA AVENUE
PITTSBURGH 12, PENNA.

Pilot diaphragm assembly of integrally mounted unit is interchangeable with upper diaphragm casing of this new top work. **Dept P, Fisher Governor Co, Marshalltown, Iowa.**

Transparent Waterproofing

RANETITE No. 5, a transparent waterproofing, combines aluminum and calcium stearic as a base to produce a seal for stone, brick and stucco walls, keeping dampness from penetrating and destroying alkali deposits. Apply waterproofing only on virgin surfaces and not over paint or oil coatings. *Ranetite* spreads about 400 sq ft per gal. It is ready for application with brush or spray if all voids are thoroughly filled. It is claimed to be absolutely transparent and not to show on outside of masonry. **Dept P. Ranetite Mfg Co, St. Louis, Mo.**


DRIVEN SHAFT OF MACHINE SUPPORTS SPEED SELECTOR. SHAFT REVOLVES AT 400 R.P.M. MAXIMUM IN EITHER DIRECTION
PLANETARY ASSEMBLY REVOLVES AT 1100 R.P.M. INSIDE STATIONARY HOUSING
V-BELT DRIVE FROM MOTOR

V-Belt Control

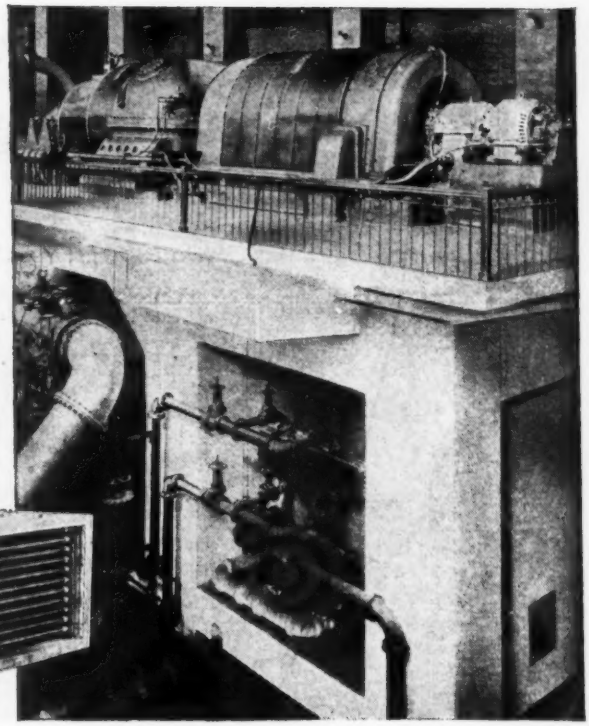
VARIABLE-V-PLANETARY SPEED SELECTOR is a development of planetary motion in which two standard cross-section V-belts and four variable-pitch pulleys provide infinite ratio, stepless speed from full, down through zero, and into full reverse at constant torque of 2-hp capacity. A slight change in variable pitch pulleys of speed selector brings a large change in output speed through multiplying action of the planetary mounted on motor or driven shaft of machine on which it is used, eliminating special mounting brackets or extra guards. Speeds from 400 rpm to zero, forward and reverse, can be obtained. Designed and developed by **Speed Selector, Inc, Cleveland, Ohio,** and merchandised by **B F Goodrich Co, Akron, Ohio.**

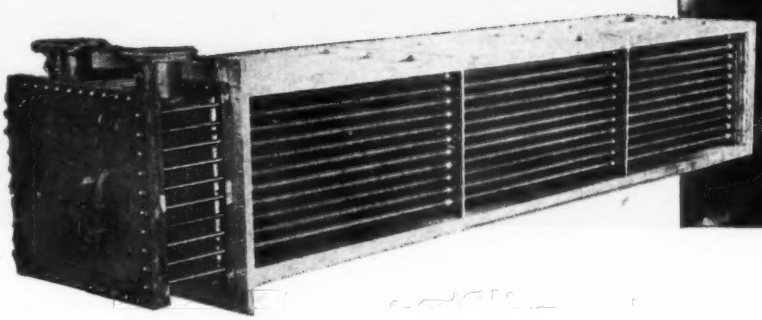
Wall-Cutting Tool

A SAW WITH TUNGSTEN-CARBIDE TEETH serves as a cutting tool. A hood connected to a vacuum cleaner carries away the dust. This device is designed for installation of heating controls. Machine cuts a groove in a plaster wall wide enough to hold copper tubing required for the equipment and sucks in dust created by the operation as it works.

After installation, channel is sealed with

A private AIR-CONDITIONING system for your GENERATORS





G-R K-FIN *Air Cooler*

Some form of cooling arrangement for turbo-generator windings is not a luxury . . . it is a necessity.

But the forced draft circulation of engine room air or cellar air as a cooling medium results in the accumulation of undesirable dust in the windings.

In many hundreds of plants, this condition is avoided by circulating the air for generator windings in a closed circuit and cooled by a G-R K-Fin Air Cooler. The benefits of this system are many . . . quieter, cooler generator operation . . . reduction of fire hazard . . . lower maintenance expense and longer life of generator . . . reclamation of electrical heat energy by using condensate as the cooling medium.

G-R Air Coolers are in use with generators totaling well over 7,000,000 kw, ranging in size from 500 kw to 160,000 kw. Write for Bulletin 1219 describing the G-R K-Fin units and their distinctive features in detail.

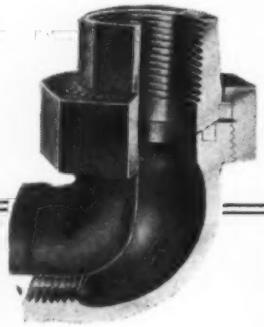
THE GRISCOM-RUSSELL CO.

285 Madison Avenue New York 17, N. Y.

GR-181

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus



"JEFFERSON" ... the UNION with the RECESSED BRASS SEAT

JEFFERSON
Specialty
UNIONS

. . . to help you make better piping layouts in less time

The 90° Union Elbow shown here is one of the typical members of the complete line of Jefferson Specialty Unions, which includes also 45° Ells and Union Tees.

This line, in addition to that of standard Jefferson Unions, has been developed to save time and material and assure fewer and tighter joints in all kinds of piping installations. In all Jefferson Unions a Recessed Brass Seat provides the means of assuring leaktightness. Furthermore this construction, exclusive with Jefferson, leaves a straight bore assuring uninterrupted flow. Location of the seat away from the bore provides protection against damage to the seat in the event that pipe ends are screwed in too far. The seating can be made drop tight without undue pressure. The wide acceptance of "Jefferson" is outstanding evidence of the many advantages offered in their design and construction.

Ask for further details or get in touch with your nearest distributor for your requirements.

JEFFERSON UNION CO.

601 WEST 26TH ST. NEW YORK 1, N. Y.

LEXINGTON 73, MASS. LOCKPORT, N. Y.

BIDDLE *SPEED MEASURING INSTRUMENTS*

The "Jagabi" Hand Tachoscope is a combined stop-watch and revolution counter for precise speed measurements. Write for Bulletin 1790 P.

Whatever your speed-measuring problems, it will be to your advantage to consult with us. We offer a variety of centrifugal, chronometric and vibrating-reed instruments. Illustrated bulletins fully descriptive of all types will be sent at your request.

James G. **BIDDLE CO.**

ELECTRICAL & SCIENTIFIC INSTRUMENTS

1316 ARCH STREET • PHILADELPHIA 7, PENNA.

plastic cement, tinted the color of wall. This motor-operated device cuts hardest plaster or cement, according to manufacturer, at speeds up to 10 ft a min. Channel depth can be determined by adjustment of a guide on the machine while a cover for cutting edge prevents dust from flying in the air. **Dept P, Minneapolis-Honeywell Regulator Co, 2747 4th Ave South, Minneapolis 8, Minn.**

Safety Glove

RED IN COLOR, STANZOIL neoprene-coated canvas glove warns worker when his hands are dangerously near moving machinery. Milled neoprene construction provides strong coating for resistance to abrasion and other hazards. It is oil and acid resistant. Curved fingers provide comfort for wearer and make gripping of tools and other objects easy. Available in one standard size, glove is made in two styles. Model No. R-26 has knit wrist and No. R-27 is furnished with gauntlet. **Dept P, Pioneer Rubber Co, 248 Tiffin Rd, Willard, O.**

Portable Pyrometer Kit

MODEL 2863 COMPACT LIGHTWEIGHT KIT contains a high-resistance portable pyrometer equipped with a "pistol grip" handle, a straight extension with adapter for iron-constantan surface thermocouple, and an assortment of thermocouples. An additional adapter is furnished for use with the bare and prong thermocouple tips, which are also included in the kit. Above items are complete with leatherette carrying case. **Dept P. Wheelco Instruments Co, 847 W Harrison St, Chicago 7, Ill.**

Centrifugal Pump

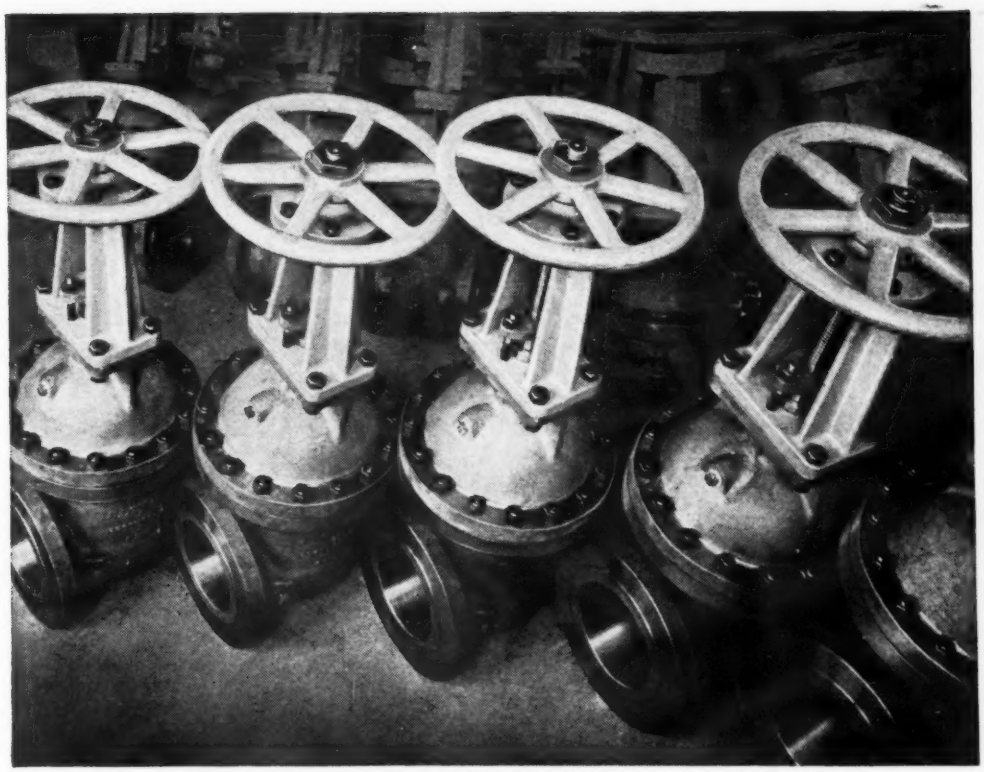
TYPE TM 4- and 6-stage high-pressure centrifugal pump ranges in capacity from 40 to 750 gpm, 700 to 1600 ft. total head. Pump is available in 1½-, 2-, 2½- and 3-in. sizes, both four and six stages.

This pump is for boiler feed and other high-pressure services. Bronze-fitted pump is standard but various other metals may be furnished for specific applications. **Dept P, Warren Steam Pump Co. Warren, Mass.**

Pipe Threader

A QUICK-SETTING WORKHOLDER and new, balanced loop handles are two innovations on *4P* geared pipe threader. Workholder enables mechanic to set threader exactly to size before being placed on pipe; once on the pipe only one screw needs to be tightened to hold it securely. All bothersome bushings have been eliminated. Balanced loop handles on inclosed gear case prevent slipping or tipping over, making it easy to pick up and put straight on pipe.

Twin-anchored drive shaft turns in oilless bronze bearings. No oil is needed. A ratchet handle is provided with each *4P* and a special, *Ridgid* design, universal-drive shaft is available for power. **Dept P, Ridge Tool Co, Elyria, Ohio.**



RESISTS ACID MINE WATERS

Stainless steel assures dependable service

These large valves, which are to be used for regulating the flow of acid mine waters, are made of stainless steel to resist corrosion. For their "tough jobs," many industries specify that valves be made of stainless steel because the resistance of the metal to wear and corrosion assures long and dependable service.

If you are interested in uses of stainless and other alloy steels, ask to receive our monthly publication, ELECTROMET REVIEW. If you need information on the production, properties, or fabrication of these steels, write our Technical Service Department. We do not make steel, but we do produce the ferro-alloys which are used in its manufacture, and our engineers have accumulated a fund of information on the use of stainless steel in many industries.

ELECTRO METALLURGICAL COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
30 East 42nd Street, New York 17, N. Y.
In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

STAINLESS STEEL

BEAUTIFUL ENDURING STRONG TOUGH

Power News

(*Continued from page* 144)

tive, and its text has been released.

Various types of nuclear-power plants were considered but cost comparisons were made with a modified Hanford-type pile since this affords more design and operating information than any other kind. Modifications of the Hanford-type would produce (1) a high enough operating temperature for power supply and (2) complete recovery of all plutonium for later consumption in the pile's power cycle.

To achieve these modifications changes in design and operating technique would be necessary, requiring extensive research and development.

While no complete nuclear-power plant, including the pile itself and all auxiliaries of a continuous thermal plant, has been built or even designed, it is felt that such a plant is possible. Under current prices a 75,000-kw plant, built along these lines in a normal, eastern U. S. locality, would cost about $25,000,000 as against $10,000,000 for a coal-fired plant of similar capacity.

Assuming operation at 100% capacity and interest of 3% on investment for both above plants, operating costs of the nuclear installation would approximate 0.8c per kwhr as against 0.65c per kwhr for the coal plant. Operating costs for coal are predicated on (1) bituminous coal of 13,500 Btu, $3.50 per ton at the mine and $7.00 per ton delivered and (2) an estimate that coal represents 55% of the plant's total operating costs. Using this reasoning a coal price of $10 per ton would give equal operating costs for both installations.

The report concluded with a list of comments, some of which were: (1) Operating costs for nuclear plant imply successful solution of any problems that arise. (2) A decrease in these costs seems reasonable as development reduces initial investment costs, high labor and supervision charges. (3) Costs for coal and other fuel have increased over prewar prices and appear to be going still higher. (4) Nuclear-power plants permit decentralization of industry since trivial amounts of fuel are needed. (5) Nuclear-power plants unlike hydro stations provide for process and heating needs; further, nuclear plants produce radioactive isotopes as a valuable byproduct for analytical medical work. (6) Nuclear power plant combined with a modern gas turbine would develop isolated areas.

WeldELLS

for example:

precision quarter-marked ends....

Those four points on each end of every WeldELL are small things to look for, but big things to find.

They make it far easier to follow center lines, angles and planes—save time, prevent errors.

Here is a feature that appeals to the practical man—an exclusive feature of WeldELLS—typical of the extra value you get in all Taylor Forge Welding Fittings.

Please note the list of extra-value features opposite. Who can doubt that a job welded with fittings which lack these features does not sacrifice something—in speed of installation, in economy, in soundness, in the lasting satisfaction that goes with using the *best!*

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Philadelphia Office: Broad Street Station Bldg.
Los Angeles Office: Oviatt Bldg.

WeldELLS alone combine these features:

- **Seamless**—greater strength and uniformity.
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- **Precision quarter-marked ends** — simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

have everything

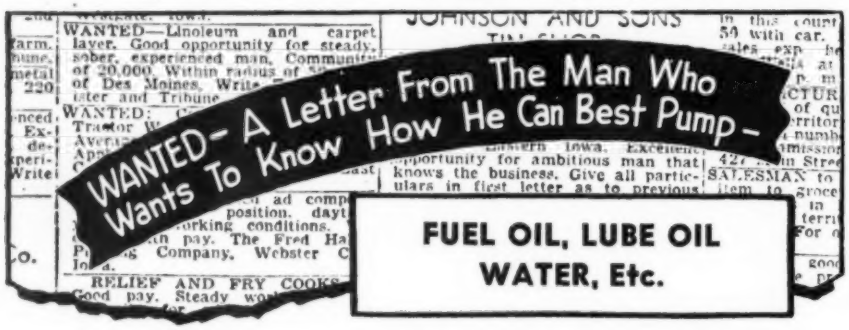
PRESSURE, TEMPERATURE, FLOW, ELECTRICAL AND LEVEL MEASURING INSTRUMENTS

UNITED STATES GAUGE

6 out of 10 manufacturers of original equipment specify U.S.G.

DIVISION OF AMERICAN MACHINE AND METALS, INC.

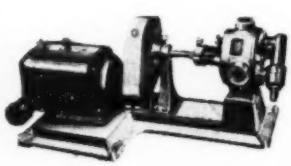
SELLERSVILLE, PENNSYLVANIA (15)


WANTED—Linoleum and carpet layer. Good opportunity for steady, sober, experienced man. Community of 20,000. Within radius of
WANTED:
JOHNSON AND SONS
opportunity for ambitious man that knows the business. Give all particulars in first letter as to previous
SALESMAN to
RELIEF AND FRY COOKS
Good pay. Steady
WANTED- A Letter From The Man Who Wants To Know How He Can Best Pump-
FUEL OIL, LUBE OIL WATER, Etc.

Do you have such a pumping problem?

Do you want to deliver it smoothly without pulsation . . . move it fast with low power consumption . . . do you want to lift the liquid up to 20 feet or up to its vaporization point as the case may be . . . do you want to move it any distance either verticle or horizontal . . . do you have limited space for the pumping unit . . . do you want a pump built for your job in the size and style needed?

If any of the above is your problem, ask VIKING today for free folder 46SW, and get the complete story about this original rotary "gear-within-a-gear" pump. It is especially adapted for solving such pumping problems.



See Our Catalog In SWEETS

VIKING PUMP COMPANY

CEDAR FALLS, IOWA

School Teachers Study War Discoveries

All-expense science fellowships awarded by General Electric to 14 women and 36 men high-school teachers of physics and chemistry are designed to teach these winners from 50 schools in nine states the theory of scientific discoveries in physics and chemistry made during the war years. In addition to a 6-week course at Union College the fellowship covers the opportunity of witnessing the application of these scientific discoveries in modern industrial laboratories through scheduled visits.

The faculty of this science session includes Dr Vladimir Rojarsky, Dr Charles B Hurd, Dr Frank J Studer, Dr Saul Dushman, Dr Paul T Goble, Dr Howard E Sheffer and Winifred M Schwarz. General Electric assistants in the presentation of the 6-week courses are: Dr Willis R Whitney, Dr Wm B Coolidge, Dr G C Suits, Truman S Fuller, Dr Albert W Hull, Dr Zay Jeffries, Everett S Lee, Dr Karl B McEachron, Dr A R Stevenson, Jr, and Karl B McEachron, Jr.

Westinghouse Electric Corp has entered a licensing agreement with the newly founded $15,000,000 Industria Electrica de Mexico, S. A. This agreement calls for American methods and standards for all technical phases of plant layout, operation and product design for an electrical-equipment manufacturer of items ranging from motors and generators to household appliances. The new plant will occupy a 190-acre tract north of Mexico City and will be under the direction of John W White, formerly president and general manager of Westinghouse Electric International Co in New York.

Regional meeting of ASME for those ten sections covering Virginia, the two Carolinas, Georgia, Alabama and Florida has been recommended by E E Williams, ASME regional vice-president. Biltmore Hotel, Atlanta, Ga., has been picked as headquarters for the April 7-8, 1947 meeting. Earle Mauldin, McGraw-Hill Publishing Co, is general chairman.

Hydroelectric Power Commission of the Egyptian government is now in the U. S. to visit the various American companies offering bids on the building of a hydroelectric station at Aswan Dam on the Nile, 500 mi south of Cairo. Project plans call for a 280,000-kw output at an expenditure of about $40,000,000. This dam is the first in a long-range plan by the Commission to develop power.

A steam turbine auxiliary test floor, which includes elaborate instrumentation, complete steam, water, oil, compressed air and electricity supplies, has been announced by Allis-Chalmers. This test floor will impose severe operating conditions on main and auxiliary oil pumps, governor and oil-pump driving gears, and governors and regulators of all types. Such tests, it is felt, will give advance knowledge of structural weaknesses.

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piping needs

SHAW

fills them quickly—
dependably

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dependable

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pre-fabrication
and installation

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President

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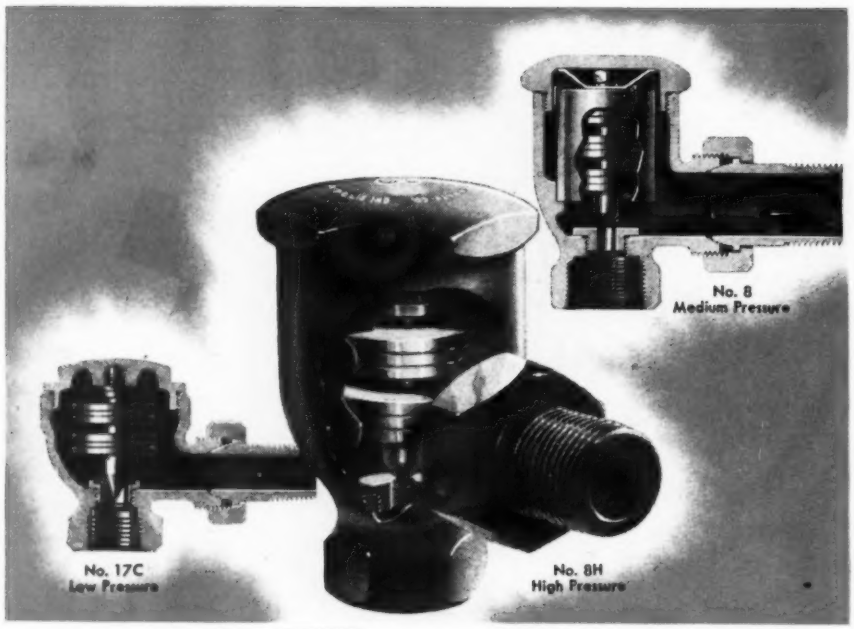


WHERE HOFFMAN TRAPS ARE INSTALLED YOU'LL FIND

OWNERS SAVING MONEY

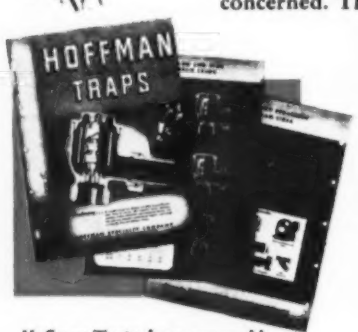
Waste of fuel at any time is an economic error. Today, with the cost of steam production rising, *it is inexcusable!*

Hoffman Traps, as cited in the above actual cases, are doing a notable job in restoring run-down or antiquated heating plants to greater efficiency—efficiency which means less fuel to produce better results.

Modernization with Hoffman Traps is a good deal for all concerned. The owner makes a reduction in operating cost which each year is equivalent to a profit . . . and the country is benefited by relief from the strain on fuel production and transportation.

For a quarter century, heating engineers have specified Hoffman Steam Specialties . . . because every refinement which adds to performance is included in them—at no greater cost! Hoffman Valves, Traps and Pumps are thus a *quality, time-tested* line of products. It is a complete line, with every specialty needed to equip either new or remodeled heating plants.

Hoffman engineers are always available for consultation.



Hoffman Traps have renewable Thermal Units and Seats. For full description send for new Bulletin TT-1145.

HOFFMAN

VALVES • TRAPS • PUMPS

HOFFMAN SPECIALTY CO., 1001 YORK ST., DEPT. P-10, INDIANAPOLIS 7, IND.

Makers of Valves, Traps, Vacuum and Condensation Pumps, Forced Hot Water Heating Systems.
Sold by leading wholesalers of Heating and Plumbing Equipment.

Industry Cooperation Sought for Blade Deposits

Allis-Chalmers Mfg Co hopes to expand the knowledge of steam-turbine-blade deposits by analyzing such deposits from any make turbine operating at a throttle pressure of 350 psi or better. To collect enough samples for a comprehensive study the steam-turbine and water-conditioning departments of Allis-Chalmers seek the cooperation of the industrial plants.

X-ray diffraction techniques are used to identify crystalline components of blade deposits. From these tests data will be collected on compounds attributable to carry-over, the occurrence of several compounds with different turbine-stage temperatures, throttle-steam and boiler-water compositions. Results of acceptable samples submitted will be forwarded to the sending-plant operators. It is further planned to make a summary of results for all cooperating, but no identification of sample source will be revealed without permission. Address requests for further information to Dr L A Burkardt, Research Laboratory, Allis-Chalmers Mfg Co, Milwaukee, Wis.

Gwilym A Price, president of Westinghouse Electric Corp, stated that sales of central-station equipment will represent 27% of 1946 business as contrasted to 2% in 1944. Today generating capacity in this country totals 51,200,000 kw as against 44,000,000 in 1944, and a now-estimated capacity of between 65,700,000 and 67,500,000 kw.

Joshua Hendy Iron Works, Sunnyvale, Calif., has signed a contract with Nordstrom Valve Co, of Oakland, to produce Nordstrom large lubricated plug valves, iron or steel, in sizes upward from 20-in. venturi and 8-in. round opening, or more. Volume, according to Harry Gunetti, Hendy's general manager, will reach $4,000,000 a year.

St. Clair Electrical Products Co, St. Clair, Mich., has set up engineering and manufacturing facilities for design and production of industrial heater and resistor units. This company occupies a portion of the Marysville Magnesium plant, formerly operated by Dow Chemical Co.

American Standards Association is conducting an inquiry by letter to 200 representative refrigeration and air-conditioning firms to find out the abbreviations, and the graphical and letter symbols now in use in the field. Sponsored by the American Society of Refrigerating Engineers, the Standards Association asked these questions:

1. What graphical symbols do you use in representing refrigeration equipment within the refrigeration cycle? (2) What letter symbols? (3) What abbreviations? The committee has asked that any firm interested and not contacted by letter send in a set of their symbols and abbreviations to D F Hayes, secy, Nomenclature Committee B53, American Standards Assn, 70 E 45th St, New York 17, N. Y.

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POWER, 330 West 42nd St., New York

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AIR CONDITIONING, HEATING, REFRIGERATION AND VENTILATING

1 **FILTERS**—Drico Industrial Corp., 29 Broadway, New York 6, N. Y. 46-page bulletin, entitled "Filters," discusses general fields of applications, attempts to clear away certain misconceptions and then touches on specific fields of use and service for filters. Many illustrations show various devices and equipment using filters.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **ALTITUDE CHAMBERS**—Refrigeration div., Bowser, Inc., Terryville, Conn. A series of four 4-page bulletins outline specifications, capacities and accessories of production testing and laboratory equipment designed to simulate high-altitude conditions of temperature, relative humidity and vacuum.

2 **GAS SCRUBBER**—Peabody Engineering Corp., 580 5th Ave, New York 19, N. Y. 4-page bulletin No. H-202, "Gas Scrubbers and Coolers," summarizes developments and applications in industry with illustrations of operating action.

3 **EVAPORATORS**—Condenser Service & Engineering Co., Inc., Hoboken, N. J. 12-page bulletin on low pressure evaporators covers company's line of low-pressure evaporators and distillers, both marine and industrial applications. In addition to illustrations, diagrams and cost data are also furnished.

4 **ROOM CONDITIONERS**—York Corp., York, Pa. 4-page bulletin describes built-in advantages of large commercial experience in small, room-sized conditioning units.

5 **EQUIPMENT CATALOG**—Fluor Corp, Ltd, Los Angeles, Calif. 24-page catalog No. 46 contains description of company's line of products as well as its engineering and construction services. Descriptions cover cooling towers, pulsation dampers, gas cleaners, mufflers and cooling units.

6 **CONDENSER TUBES** — Wolverine tube div, Calumet and Hecla Consolidated Copper Co, 1411 Central Ave, Detroit 9, Mich. 16-page bulletin, entitled "Condenser Tubes," tells of the alloys used in condenser and heat exchanger applications, their chemical and physical characteristics, tables for aiding in tube selection and a graph giving safe working pressures for tubes of varying sizes diameter and gage number.

BOILERS AND AUXILIARIES

7 **OIL BURNER**—American Heat Corp, Lowell, Mass. 4-page bulletin covers performance claims on company's Arc-Heat burner. Illustrations of burner appear in bulletin.

8 **DUST PRECIPITATOR** — Raytheon Mfg Co, Waltham 54, Mass. 8-page bulletin No. DL-P-503 and 4-page bulletin No. DL-P-505 discuss (1) major ele-

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ments in company's precipitator unit (2) capacities in cfm at 85 and 90% efficiencies (3) cells required and cell size (4) framework dimensions (5) power supply and (6) approximate weights.

9 BOILER BLOWOFF—P E Madden & Co, 352 W Walton St, Chicago 10, Ill. 6-page bulletin outlines various features, applications and installations of its continuous blowoff system. Final page lists many typical uses of this product.

10 AIR PREHEATERS—Air Preheater Corp, 60 E 42nd St, New York 17, N. Y. 8-page bulletin No. A-11610, entitled the "Ljungstrom Air Preheater," develops by separate treatment the uses, benefits, efficiency and capacity effects, as well as a general description of the elements and operation of an air preheater.

11 WATERTUBE BOILER—Springfield Boiler Co, Springfield, Ill. 4-page bulletin on Type M Springfield standardized boiler includes cross-sectional views of the unit, built-in features, construction details and a "How to Order" table covering measurements and operating data of available models.

12 DUST COLLECTORS—Aerotec Co, White Plains, N. Y. 4-page catalog No. 310 first treats the problem of dust in industry and then discusses performance charts, capacity and dimension tables, as well as operating facts.

13 WATERTUBE BOILERS—Babcock & Wilcox Co, 85 Liberty St, New York 6, N. Y. 58-page bulletin, entitled "Central Station Boilers," gives cross-sectional diagrams, individual central station and company names, as well as operating and design data. Boilers are grouped by major headings such as Stirling boilers, high head boilers, etc.

14 FURNACE REFRACTORIES—Ironton Fire Brick Co, Ironton, Ohio. 4-page bulletin, information circular No. 22, covers background, major uses, present applications and characteristics of Ironton Berlite as developed for largely industrial process use.

15 BOILER BLOWOFF — Cochrane Corp, Philadelphia, Pa. 10-page bulletin No. 45, entitled "Continuous Blowoff for Boiler Plants," is a two-part reprint of previously published material. Part I demonstrates calculations and graphic chart picturizations of estimating continuous blowoff savings. In addition a table of recommended solids concentration, and calculations with typical problems of water saved. Part II covers the flash principle, types of systems and points on selection of heat exchanger equipment.

16 MECHANICAL STOKERS—Whiting Stoker Sales Co, 11 South LaSalle St, Chicago 3, Ill. 6-page bulletin No. 608, "HC Stokers," contains mechanical details and specifications, operating theory, and drawings of rear and front arch arrangements with indicated dimensions of major parts.

17 FEEDWATER REGULATOR—Northern Equipment Co, Erie, Pa. 4-page bulletin No. 455, "Controlling Water Level," is an operating story on performance of this company's Copes Flowmatic regulator at a New England utility power plant.

COMPRESSORS AND ACCESSORIES

18 AIR COMPRESSOR—Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y. 32-page bulletin, Form 3166-C, "Air Compressors," treats the company's Type 40 compressor from many angles. Front of the booklet deals with major possible locations for compressors and their adaptability in these locations. Design features, valves, compression theory, cooling, radial construction, regulation ratings and drive close out this method of treatment. Rear of the book pictures many compressors installed in various industries and for various services.

19 ROTARY COMPRESSOR — Allis-Chalmers Mfg Co, Milwaukee 1, Wis. 16-page bulletin No. 677 approaches rotary compressors and turbo blowers from a student's viewpoint. It establishes principal construction details then goes on to stress importance of complete ordering information. Curves depict pressure volume, influence of water vapor on volume and connection curves for volumes to maintain constant air weight with changes in temperature and barometric pressure.

20 AIR-DRIVEN TOOLS — Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y. 4-page bulletin, Form 102, presents a list of maintenance tools suitable for many uses. Illustrations of most of these tools and pictures of some at work feature the presentation. Mention is made and models shown of company's mobile compressor unit and two of its smaller compressors suited for auxiliary needs in plant operation.

CONTROLS, MECHANICAL

21 ENGINE CONTROLS — Synchro-Start Products, 1046 West Fullerton Ave, Chicago 14, Ill. 12-page bulletin, "Products Catalog," lists the company's full line of controls with short descriptions of each item. A 2-page summation of typical industrial uses of these products closes out the booklet.

22 TIME CONTROLS—Automatic Temperature Control Co, Inc, 34 E Logan St, Philadelphia 44, Pa. 4-page bulletin T-55 concentrates on the low-cost, special needs for original equipment manufacturers. Six sample case histories with illustrations of the operation involved and the equipment employed furnish on the job applications of the company's products in this line.

23 PROCESS CONTROLLERS — Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio. 8-page bulletin No. 17, entitled "Instruments and Controls for Process Industries," presents process controllers, with eight illustrations and specific operating data for each cited case, similar treatment for control components, air-operated type, and finally a concise illustration-exploration technique for various measuring components of indicators, recorders, controllers.

24 COMBUSTION INDICATORS—Ess Instrument Co, George Washington Bridge Plaza, Fort Lee, N. J. 4-page bulletin No. N-789 and 2-page bulletin No. 385 cover an electric-eye operated combustion indicator, a diesel haze gage, a flame gage, a haze gage and three recorders, operation, indicator and potentiometer. Specifications, power requirements also appear for above products.

25 COMBUSTION CONTROL—General Power Plant Corp, 381 4th Ave, New York 16, N. Y. 4-page bulletin discusses operating advantages possible from smoke control. A line drawing shows connection for the Robot-Eye in the combustion system.

(*Continued on page 192*)

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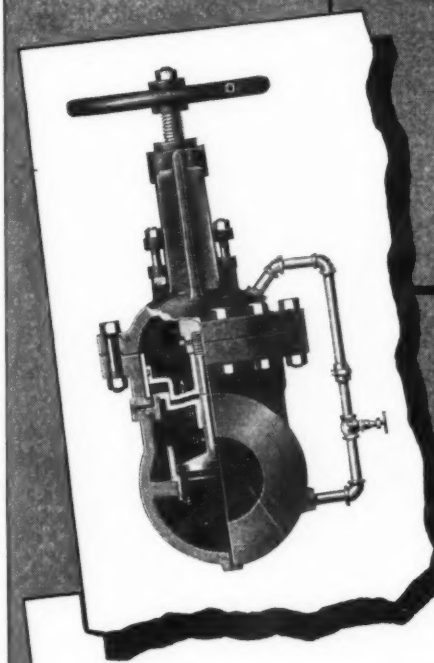
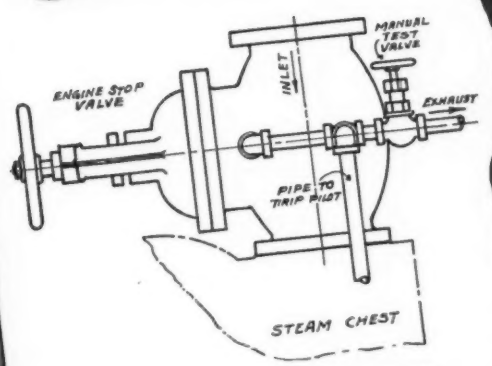
HOW TO AUTOMATICALLY PREVENT

TURBINE OR ENGINE OVERSPEEDING



install

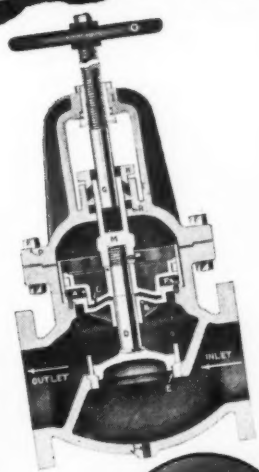
GOLDEN-ANDERSON THROTTLE and AUTOMATIC ENGINE STOP VALVES



Golden-Anderson Throttle-Engine Stop Valve in horizontal position with downward steam flow.

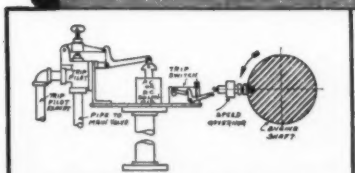
On overspeeding of engine or turbine the shaft governor may directly operate trip pilot control valve or limit switch, if solenoid trip pilot control is used, to open trip pilot control valve and permit engine stop valve to instantly close and stop engine or turbine.

By running down handwheel stem the valve may be closed any time, and by-pass valve should be closed when the valve is to be maintained in closed position over a period of time.

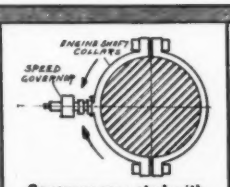


Free Engineering Aid...

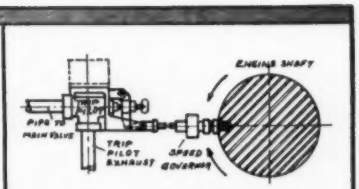
Let GOLDEN-ANDERSON engineers help you on any new or replacement valve problem.



Electric trip pilot and switch assembly with governor attached to engine shaft.



Governor mounted with split collars attached to engine shaft.



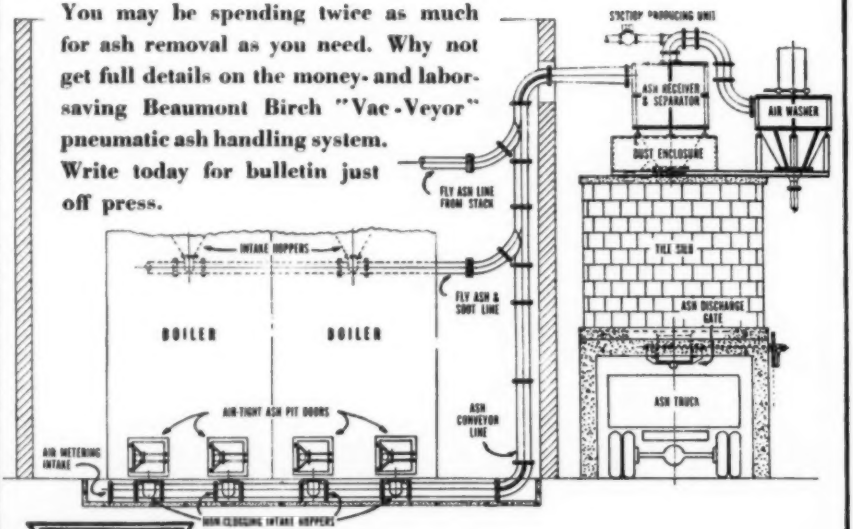
Mechanical trip pilot assembly with governor attached to engine shaft.

GA **GOLDEN-ANDERSON VALVE Specialty Company**

KEENAN BUILDING · PITTSBURGH 22, PA.

HOW MUCH ARE YOU PAYING TO HANDLE ASHES?

You may be spending twice as much for ash removal as you need. Why not get full details on the money- and labor-saving Beaumont Birch "Vac-Veyor" pneumatic ash handling system. Write today for bulletin just off press.



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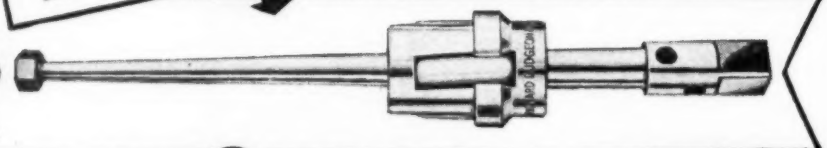
The fact that DUDGEON products embody a skillful blend of laboratory and "on-the-job" research is an important factor in their superiority. Combine this engineering policy with new methods and rigid quality control at every stage of production and you have these important reasons for DUDGEON'S century-old leadership in providing better tube expanders, in more diversified types—at lower cost.

DUDGEON TYPE 16
DUDGEON offers this new Series of expanders as a real contribution to job cost reduction. Design simplification and the reduction of component parts have made these lower cost units possible without any sacrifice in efficiency or durability.



RICHARD *Dudgeon* INC.

MFRS. OF TUBE EXPANDERS SINCE 1853

24 COLUMBIA STREET, NEW YORK 2, N.Y.

New Bulletins

(*Continued from page* 190b)

26 CONVERSION BURNER — York-Shipley, Inc, York, Pa. 12-page bulletin No. ID-4-6H, entitled "Precision Combustion," describes flame adjustment, air-oil control and a pressure igniter on company's burner built for the full range of industrial boilers. Actual operation charts, piping diagram and illustrations of two burner types also appear in the bulletin now available.

ELECTRICAL EQUIPMENT

27 LIGHTING EQUIPMENT—Edwin F Guth Co, 2615 Washington Blvd, St Louis, Mo. 4-page bulletin, entitled "America's No. 1 Lighting Job," describes installation at West Point of fluorescent lighting units by the company.

28 AUTOSWITCH — Apparatus Dept, General Electric Co, Schenectady, N. Y. 4-page bulletin No. GEA-4624, "Watt-Var Autoswitch," discusses application, general background, operating principle and construction details of this primarily central station or industrial substation equipment. Information is also furnished on the associated recorders that enable power factor studies on loaded circuits.

29 ELECTRICAL CONNECTORS—National Electric Products Corp, Pittsburgh, Pa. 12-page booklet No. 466, entitled "Mechanical Principles of Gorilla Grip Electrical Connectors," shows cutaway models, schematic drawings and illustrations of various connectors to aid engineers, jobbers, contractors and industrial purchasing agents in design and function of these connectors.

30 INDUCTION MOTOR—Louis Allis Co, Milwaukee 7, Wis. 10-page bulletin No. 720 covers construction, features and some applications of a protected squirrel-cage motor. Pictures illustrate principal phases of the discussed material.

31 PORTABLE LAMP—U-C Lite Mfg Co, 11 East Hubbard St, Chicago 11, Ill. 6-page bulletin shows various uses of a portable hand lamp.

32 ELECTRIC TRANSFORMERS — Allis-Chalmers Mfg Co, Milwaukee, Wis. 4-page bulletin No. B6382 describes the dry transformer from six feature points. Mechanical data, list prices, representative connection diagrams and pictures of various capacity units are shown.

33 ELECTRIC MOTORS — Apparatus Dept, General Electric Co, Schenectady, N. Y. 8-page bulletin No. GEA-4400, "The Tri Clad," and 26-page bulletin No. GEA-4131, "Motors and Control for Hazardous Locations." The first of these covers company's protective, dripproof motor and illustrates by construction and sectional views supported by text the protective features offered. In the second bulletin a detailed presentation of hazardous locations, development of explosion-proof equipment, tests imposed and regulations on uses and wiring employed forms front half of the bulletin, with pictures and descriptive material on the company's line of explosion motors making up the last half.

34 ELECTRIC MOTORS—Century Electric Co, St. Louis 3, Mo. 8-page bulletin Form 643 covers slip ring induction motors with typical speed torque curves, construction details, mechanical forms and bearing and brushes all discussed.

35 ELECTRIC TRANSFORMERS — Westinghouse Electric Corp, P O Box 868, Pittsburgh, 30, Pa. 16-page booklet No. A-34433, entitled "CSPB Transformers," discusses banked secondary systems. Various systems, radial, network, conventional secondary banking and a banked secondary appear in diagrams using the CSPB transformer with a circuit breaker built-in in addition to one for thermal protection. Booklet goes on to illustrate by sectional diagrams how transformer clears faults, indicates tripped breakers and gives load indication.

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...of unlimited applications!

"Electrifugal" principle saves space.. cuts costs

BUILDING BOTH pump and motor on the same shaft — in one rigid frame — does *more* than assure compactness, perfect alignment and lower initial cost. It gives you a pump of almost unlimited uses... available in stock sizes from ¾ to 25 h. p.

Allis-Chalmers builds both pump and motor — thoroughly tests each unit for capacity, efficiency and head. For a wide range of pumping jobs, Allis-Chalmers "Electrifugal" pumps will save you money — in first cost — in installation — in operation and maintenance.

PUMPS FOR EVERY PURPOSE

Allis-Chalmers designs and builds a complete line of centrifugal pumps and motors . . . assumes undivided responsibility for their performance. Single or double suction, single and multi-stage, capacities up to 170,000 gpm. For help on any pumping problem, call on your nearest A-C office or dealer. Ask for bulletin B6059. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

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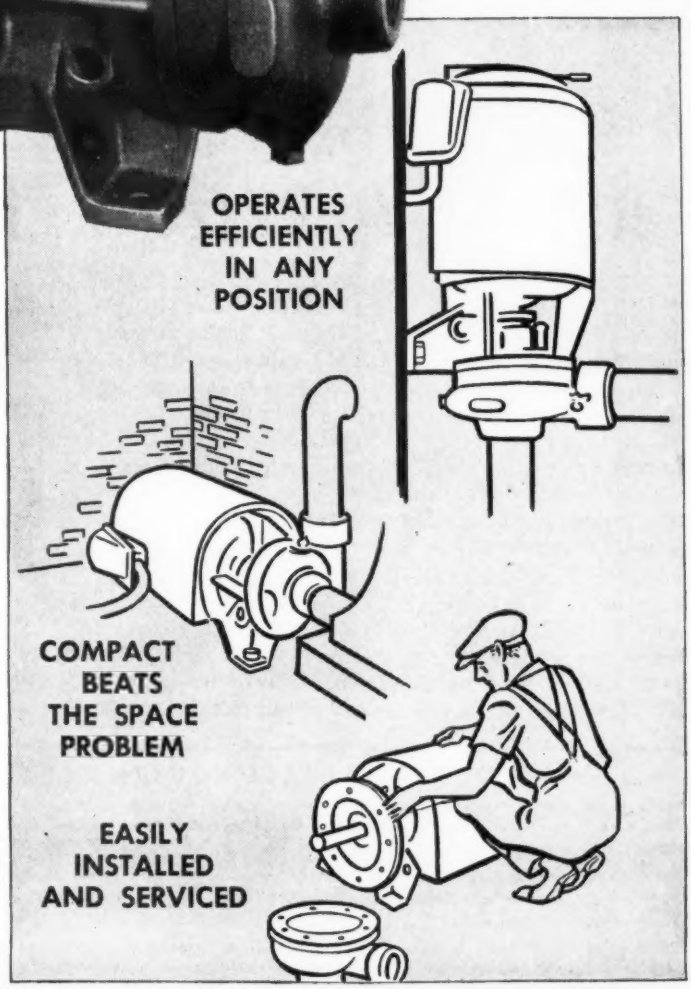

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Biggest of All in Range of Industrial Products

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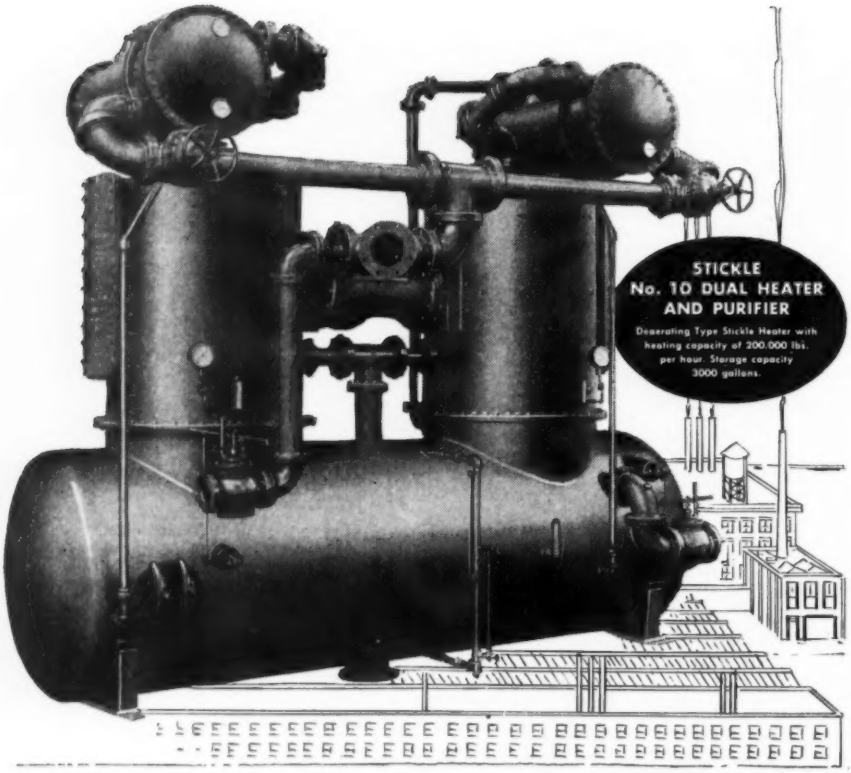
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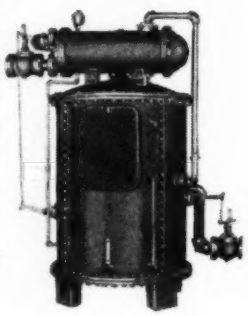
No. 10 DUAL HEATER
AND PURIFIER
Deaerating Type Stickle Heater with heating capacity of 200,000 lbs. per hour. Storage capacity 3000 gallons.

A STICKLE HEATER FOR YOUR CAPACITY REQUIREMENT

● The advantages of Stickle Open Coil Feed Water Heater Construction are available, alike, to small and large industries. Stickle Open Coil Feed Water Heaters and Purifiers are built in sizes for capacities of a few hundred gallons per hour to many thousands of gallons per hour. Heating more water to higher temperature in less space, operating indefinitely at high efficiency, requiring a minimum of attention and with upkeep negligible over a long period of service, Stickle Heaters have proved their superiority in practically all types of industry using steam.



No. 6 Stickle Open Coil Heater, Deaerating Type

Stickle Deaerating Heaters deliver feed water to pump with oxygen content not greater than 0.3 cc. per liter; with larger quantities of all scale-forming substances removed; and at temperature within two degrees of saturated steam in heater. Fully one-sixth of boiler supply pure distilled water condensed in heating. Bulletin No. 117 supplies complete information and data.

OTHER STICKLE EQUIPMENT

Stickle Differential Drainage and Boiler Return System—a closed pumping system that returns condensate under pressure from processing units to boilers at temperature only slightly lower than that at which it leaves traps. Bulletin No. 250.

Stickle Regulating and Reducing Valves—two series in standard types designed and constructed for industries requiring dependable and accurate control within extremely close limits of variation. Bulletins Nos. 235 and 435.

Stickle Open Float Steam Traps—in four series designs to meet specific operation conditions. Traps for high, medium, and low pressures and for vacuum service. Specify use in request for bulletin.

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SPECIALIZING FOR MORE THAN 40 YEARS IN REDUCING THE COST OF STEAM

36 ELECTRICAL PRODUCTS — Allis Chalmers Mfg Co, Milwaukee, Wis. 16-page bulletin No. 655 entitled "Electrical Products," covers eight classifications of equipment ranging from motors to electronic heaters. Booklet includes motor controls, multiple V-belt drives, low- and high-voltage transformers, switchboards, switch gear and circuit breakers, pumps, power generation equipment and water conditioning chemicals.

37 ELECTRIC MOTORS — Crocker-Wheeler Electric Co, Ampere, N. J. 2-page bulletin No. SL-300-3 concerns itself with protected motors for close coupled service. In addition to descriptive material a table of dimensions for flange mounting and face mounting types is given.

CONTROLS, ELECTRIC

38 ELECTRIC INSULATORS—General Ceramics and Steatite Corp, Keasbey, N. J. 48-page catalog No. 2000 divides into ten main sections ranging from manufacture and characteristics through design criteria. Sections are devoted to bushings, lead-in, spreader and strain insulators.

39 SILICONES—Dow Corning Corp, Midland, Mich. 5-page reprint, entitled "The Application of Silicone Resins to Insulation for Electric Machinery," and a 4-page bulletin, Resin Series No. 1, "How to Use DC996." The first paper describes application of silicone resins on rotating apparatus. This paper was awarded an AIEE award. The second bulletin is designed for rewind and electrical maintenance shops. Tables give properties and specifications.

40 BUS DUCTS—Westinghouse Electric Corp, P O Box 868, Pittsburgh 30, Pa. 40-page booklet, A34441, analyzes and diagrams three bus duct installations. Engineering data includes ratings of main breakers, temperature conversion tables, formulas for determining amperes, horsepower, kilowatts, kilovolt-amperes, etc.

HEAT EXCHANGERS

41 WATER HEATERS—Marion Machine, Foundry & Supply Co, Marion, Indiana. 4-page and 28-page bulletins entitled "Marion Gulf Stream Water Heater." The 4-page one shows a cutaway view of the heater, describes its construction, certain of its features and a list of information required to execute an order promptly. The 28-page bulletin lists capacity ratings of water heaters using steam at gage pressures from 1 to 150 psi and for temperature rises from 20 to 150 F.

42 CONVECTOR RADIATION—Modine Mfg Co, Racine, Wis. 16-page bulletin No. 246 discusses convector heating for commercial and institutional buildings as well as residences. Various inclosure types, their dimensions, installation capacities and specifications comprise the discussion.

43 DEAERATORS — Cochrane Corp, Philadelphia 32, Pa. 20-page bulletin No. 4160, "Atomizing Deaerators," covers operating principles, comparisons with other types, action under waters different in chemical content, types of designs. Sectional drawings and pictures of equipment illustrate the booklet.

44 HEAT TRANSFER—Griscom-Russell Co, 285 Madison Ave, New York 17, N. Y. 8-page bulletin No. 1261 illustrates and describes evaporators, heaters, coolers, condensers and heat exchangers for liquids, vapors and gases found in chemical process work. A 2-page index aids in finding units suitable for specific fuels.

MAINTENANCE AND SAFETY EQUIPMENT

45 MACHINERY PRODUCTS—Ideal Industries, Inc, 1296 Park Ave, Sycamore, Ill. 24-page bulletin, entitled "Ideal Machinery Products," covers company's full line of tools and mechanical aids. Included are etches, drills, grinders, screw drivers, pneumatic tools, chucks, tachometers and demagnetizers.

46 SCREENS—Morrow Mfg Co, Wallston, Ohio. 52-page handbook No. 70 covers data tables, specifications, materials, how to order information and illustrations of three perforated plate screens, flat, step, conical and cylindrical.

Designed TO WORK MORE EASILY—
Built TO LAST LONGER—

ASBESTOS-PACKED COCKS

READING-PRATT & CADY

That, in brief, is the story of this double gland Asbestos-Packed Cock—a **READING-PRATT & CADY** "original."

This cock serves best as a shut-off on lines that carry solids in suspension—viscous fluids—oils—acids and alkalis—steam (for boiler blow-off)—in short, wherever Globe, Angle or Gate valves fail or where conventional ground plug cocks prove unsatisfactory. It is made in cast iron, bronze and cast steel.

U-shaped grooves in the body of this cock are packed solidly with asbestos, which is then vulcanized. This provides a bearing which absorbs expansion and eases operation. The double gland feature—independently controlled pressure on plug and top packing—still further eases operation and prolongs life.

R-P & C offers you a single responsible source for bronze, iron and steel gate, globe, angle and check valves—cocks and lubrotite gate valves—bar stock valves—cast steel fittings—D'Este Automatic Valves and Engineering Specialties.

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There are plenty of big jobs today in Combustion Engineering. Such jobs have always been big pay jobs —and today they are better than ever. High fuel and equipment costs means a greater demand for combustion trained men than ever before.

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47 FIRE HOSE—American-LaFrance-Foamite Corp, Elmira, N. Y. 8-page bulletin No. AD-8002 gives illustrations of its all weather fire hose in its finished form, and at various stages in its testing and manufacture. Information is also supplied on its protection against mildew and climate.

48 DRILLS—Chicago Latrobe Twist Drill Works, 411 Ontario St, Chicago 10, Ill. 4-page leaflet on heavy duty drills gives in table form, price information as well as size data on this class of drill.

49 FIRE PROTECTION—Randolph Laboratories, 8 E Kinzie St, Chicago 11, Ill. 20-page booklet No. R-5827, entitled "How to Fight Fires and Protect Property," explains by text and illustration latest techniques in fighting fires with carbon dioxide and other fire extinguishers.

50 VIBRATION INSULATORS—B F Goodrich Co, Akron, Ohio. 12-page bulletin No. 6-7320-GI gives an outline on selection of the company's vibro-isolator type for a specific requirement, cites many applications and furnishes a complete table of characteristics of each type.

51 LOCK NUTS—Elastic Stop Nut Corp of America, Union, N. J. 16-page booklet No. ADL 468 covers testing procedure for determining locking effectiveness of self-locking nuts and related fastening devices, equipment, procedure for tests on vibration, torque (removal, reuse and installation) wearing and plating.

52 ELECTRONIC EQUIPMENT—Westinghouse Electric Corp, East Pittsburgh, Pa. 30-page booklet No. B 3658, entitled "Maintenance of Industrial Electronic Equipment," describes operating maintenance procedure for various elements in this class of electronic equipment. Many illustrations of these elements, and in some cases of tools and maintenance procedure, serve to supplement the text.

MAINTENANCE MATERIALS

53 PROTECTIVE COATINGS—Rand-Williams Mfg Co, 377 Broadway, New York 13, N. Y. 36-page bulletin, entitled "Mixtite Asphalt Powder Mix" describes the nature of a waterproofing material and its preparation for use. Many illustrations and explanations are advanced on its different applications.

54 PRESSURE PACKING—National Supply Co, Toledo 1, Ohio. 8-page bulletin No. 328 is the first of the company's new series of "How To" product bulletins. In addition to specifications, detailed sectional drawings, a group of photographs illustrate installation of pressure pack equipment.

55 FELT SEALS—American Felt Co, Glenville, Conn. Data Sheet No. 11 deals with uses of plain and laminated seals. Selection of proper types, tables of tolerances, housing compressions and oil absorption capacities form information supplied by company's laboratories.

56 GASKETS—United States Gasket Co, Camden, N. J. 30-page catalog No. 303 gives company's line, both standard and special, for various different metals and materials. All temperature and pressure ranges, normal to industrial, marine, chemical, petroleum and power plant are covered. Reference tables give gasket data.

57 ROOFING REPAIRS—Stonhard Co, 401 No Broad St, Philadelphia 8, Pa. 6-page folder, entitled "Hidden Hazards on Your Roof," discusses repair and waterproofing of cracked or dried out roof surfaces.

58 CASTING REPAIRS—Metalock Casting Repair Service, Long Island City 1, N. Y. 5-page reprint and 24-page bulletin. Reprint describes repairs to steam turbine unit following hydrogen explosion. Bulletin tells of company's service for ferrous and non-ferrous-metal repairs, explains different methods of repair service and offers illustrations of many on the job applications.

59 HEAVY FLOORING—Wm F Klemp Co, 6601 S Melvina Ave, Chicago 38, Ill. 6-page leaflet No. 405 5M744 describes Hexteel, a heavy, steel grid fit for imbedding in concrete. A series of industrial installations and detail drawings of different anchoring methods further this description.

INCREASES BOILER EFFICIENCY

YOU CAN CHECK the efficiency of XZIT in your boiler room. Stack temperatures definitely prove that XZIT substantially increases operating efficiency and improves heat transfer by removing soot and fire-scale from all surfaces of the firebox and stack.

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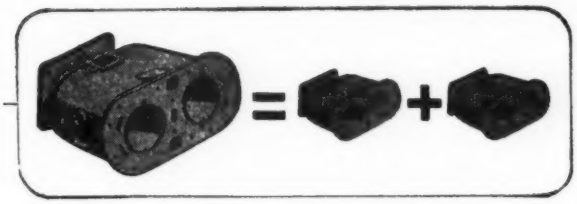
XZIT FIRE SCALE & SOOT ERADICATOR
1031 CLINTON STREET, HOBOKEN, N. J.
5800 S. HOOVER, LOS ANGELES, CALIF.



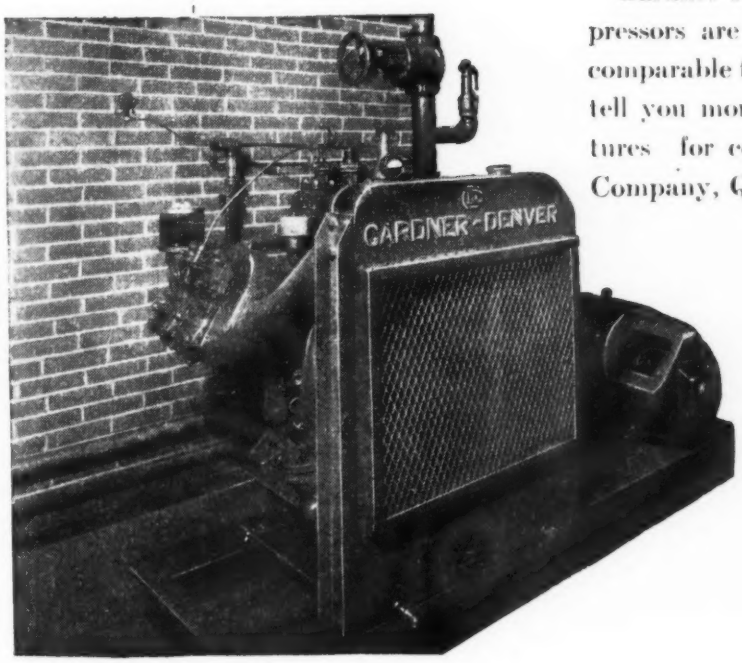
for you . . .

we made
little cylinders
out of big ones!

Conventional air compressor design calls for one large, low pressure cylinder in conjunction with each high pressure cylinder. But Gardner-Denver engineers were not satisfied merely to follow established practice. So, in designing the Class WB Two-stage Vertical Water-cooled Compressors, Gardner-Denver engineers put in *two* small diameter, low pressure cylinders for each high pressure cylinder.

Thousands of "WB" compressor owners have reaped the benefit! For the unique "WB" design permits lower air temperatures—with corresponding saving in horsepower. Inertia loads are reduced because all pistons can be small and lightweight. Better water cooling is possible—and that, in turn, means better lubrication, reduction of cylinder distortion, and longer life. "Oil thinning" is eliminated and thus much less lubrication oil is used.

Gardner-Denver "WB" Vertical Water-cooled Compressors are remarkably compact—yet have efficiencies comparable to that of large horizontal compressors. Let us tell you more about their space-saving, cost-saving features for complete information, write Gardner-Denver Company, Quincy, Illinois.



Gardner-Denver Class "WB" Two-stage Vertical Water-cooled Compressor—available with built-in motor with V-belt or direct drive. Capacities 142 to 445 cubic feet displacement per minute.

GARDNER-DENVER

Since 1859

THE NEW
REX MACHINE TOOL CONDUIT
TYPE M. T. C.
. . . by CHICAGO METAL HOSE

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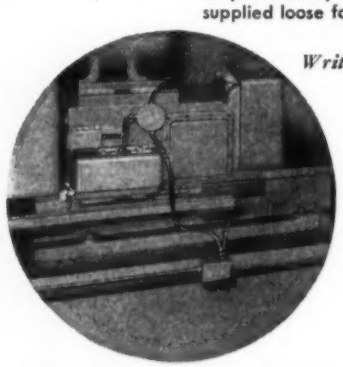
- Flexible metal hose liner
- Synthetic cover
- Extremely flexible
- Smoothness of flexible metal hose bore prevents excessive abrasion
- No detrimental abrasive surfaces throughout hose-fitting assembly
- Liquid-tight externally
- Liquid-tight steel fittings—usable with both standard and water-tight conduit boxes
- Fittings are attachable and re-attachable by user—or can be permanently attached at factory
- Sizes from ⅜-in. I. D. to 1½-in. I. D. inclusive
- Furnished in mill lengths or cut lengths, with factory-attached fittings both re-attachable or permanently attached—or with fittings supplied loose for user to attach.

Write for Bulletin M. T. C.—46



Flexible Metal Hose for Every Industrial Use

CMH
CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS
Plants: Maywood and Elgin, Ill.

60 LUBRICATING OIL—Sun Oil Co, Philadelphia 3, Pa. 6-page folder No. A-1347 pictures industrial operations employing Suntac No. 502 oil and describes desirable features credited to this oil.

61 FLOORING — Walter Maguire Co, Inc, 330 W 42nd St, New York 18, N. Y. Bulletin No. 602 gives specific installation data, nine features and test data on operating life and materials of the company's Emeri-Crete flooring.

62 FLOOR TREATMENTS — Truscon Laboratories, Inc, Caniff and GTRR, Detroit 11, Mich. Book B covers floor treatment, concrete and wood, with complete and short specifications, illustrations and description of each product on the reverse side of its specification sheet. Five subdivisions, integral hardness, chemical hardeners, concrete dye, surface coating and wood floor preservatives, serve to present this data in usable form.

MATERIALS HANDLING

63 EARTH MOVERS—R G LeTourneau, Inc, Peoria, Ill. 4-page bulletin No. G-1077 describes by photo and caption certain earthmoving jobs handled with company's Tournapulls.

64 MOVING SCREEN—Robins Conveyor Inc, Passaic, N. J. 12-page bulletin No. 111-A illustrates and explains by photo and text operating action of the Eliptex screen and its three component system. Mechanical features, as well as applications for its use, dimensions and clearances are stated.

65 ASH HANDLING—Beaumont Birch Co, 1505 Race St, Philadelphia 2, Pa. 39-page company catalog assembles data and bulletin on the Vac-Veyor pneumatic system. Material includes discussion of operating principle, cutaway views of major equipment elements, dimensions of elements and illustrations of valves, pipes and fittings, etc.

66 ELEVATOR MACHINES—Otis Elevator Co, 260 11th Ave, New York 1, N. Y. Catalog insert No. B-506 gives features of a geared traction machine, No. 14AT.

67 RUBBER CONVEYORS—B F Goodrich Co, Akron, Ohio. 28-page booklet, entitled "Industrial Rubber Products," gives company's complete line of flat transmission belting, conveyor belting, fractional horsepower V-belts and sheaves, multi-V belts and sheaves. In addition there is material on couplings, adhesives, putties, packing, hard and sponge rubber, industrial clothing and rubber gloves.

68 HOSE AND COUPLINGS—Seamlex Co, Inc, 41-23 24th St, Long Island City 1, N. Y. 2-page bulletin No. 20 insert is an index for use with the company's catalog and aids in proper selection.

69 BUCKET ELEVATOR—Link Belt Co, 307 N. Michigan Ave, Chicago 1, Ill. 4-page bulletin No. 1983 portrays through cutaway drawings, text and photos an internally-loaded bucket elevator for gentle handling of small parts.

70 CHAINS AND SPROCKETS—Union Chain and Mfg Co, Sandusky, Ohio. 16-page catalog D-1 gives information, illustrations, specifications on chains and sprockets, roller chains and sprockets, silent chains and sprockets and flexible couplings.

MECHANICAL TRANSMISSION

71 V-BELT DRIVES—Dayton Rubber Mfg Co, Dayton 1, Ohio. 384-page catalog No. 280 divides into six major classes, V-belt drives, V-flat drives, supplementary drive tables, engineering data on special drives, prices and dimensions, and an interchangeability list. A further division by subject and page number is another feature.

72 BELT FASTENERS — Armstrong-Bray & Co, 5364-76 Northwest Highway, Chicago, Ill. 10-page catalog No. 10 covers company's list of belt fasteners, specifications, prices. Several pages are devoted to wheelpullers.

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Besides cutting fuel costs, Clarage Unit Heaters will help your plant maintain *top-level production* so dependent upon healthy, comfortable temperatures.

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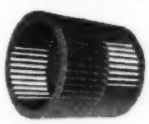
FEATURES!



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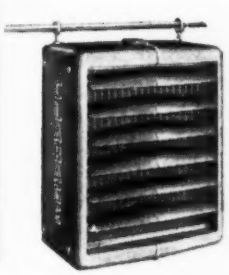
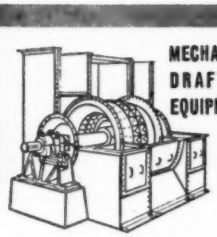
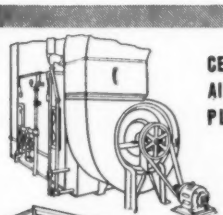
Clarco Unit Heaters (at right) are for small space heating, and for "spots" where more heat is needed than present equipment can supply. Exceptionally quiet — ideal for offices and stores as well as factory service. Wide range of sizes, using steam or hot water.



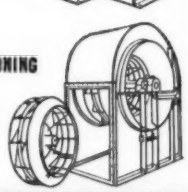
SOME OF OUR OTHER PRODUCTS



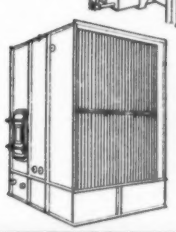
MECHANICAL DRAFT EQUIPMENT



CENTRAL STATION AIR CONDITIONING PLANTS



AIR CONDITIONING AND VENTILATING FANS



AIR WASHERS

Sorry, but the large volume of orders already accepted prevents deliveries for 1946 heating season. We would, however, appreciate an opportunity to figure your future unit heater requirements.

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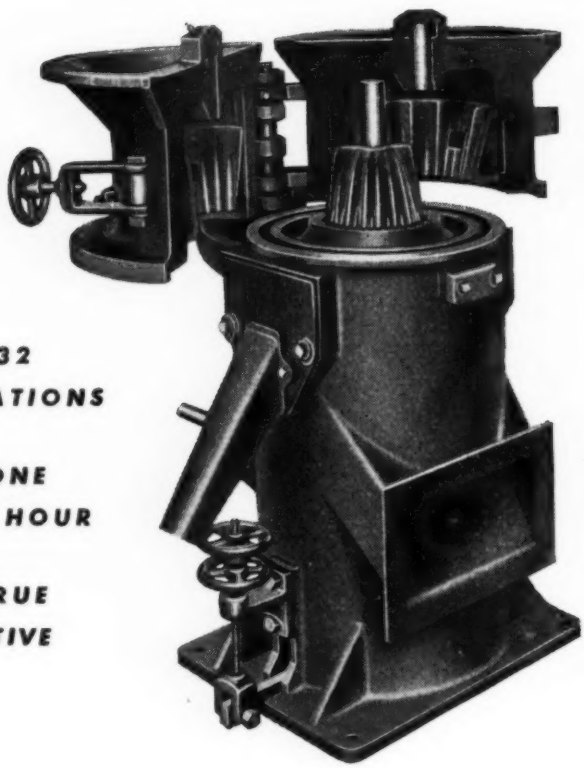

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The Sturtevant automatic coal sampler enables you to make accurate coal samples quickly and easily. All you do is feed the coal or coke into the hopper . . . the sampler does the rest, discharging a homogeneously representative mixture through the sample spout ready for analysis.

The Sturtevant method eliminates 32 of 34 hand operations, thus speeds sampling work and cutting costs by providing accurate samples in a few minutes. Get the Sturtevant story. Write for information and bulletin today.

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METALS AND ALLOYS

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **WIRES, RODS**—Alloy Metal Wire Co, Prospect Park, Pa. 24-page catalog No. D-2 supplies engineering information on strength, heat treatment, temperature limits and magnetic properties. In addition to sizes, weights, tolerances, there are many illustrations of wire, rod and strip.

73 **MOLDS**—Mechanite Metal Corp, 500 Pershing Square Building, New Rochelle, N. Y. 4-page bulletin No. 23 shows illustrations and gives text of company's castings in production of metals, glass, plastics and rubber.

74 **MAGNETIC METALS**—Westinghouse Electric Corp, Box 868, Pittsburgh 30, Pa. 48-page booklet No. B-3369 details company's magnetic metals and alloys by various sections, as follows: (1) magnetic metals (2) electrodes, filament and contact metals (3) glass sealing alloys (4) brazing and soldering alloys (5) high temperature alloys.

75 **MILL PRODUCTS**—Ampco Metal, Inc, 1745 S 38th St, Milwaukee 4, Wis. 16-page bulletin No. 64B furnishes tolerances, weights, physical properties and mill lengths of rods as well as data on rolled sheets.

METERS AND INSTRUMENTS, MECHANICAL

76 **OIL FLOW**—Askania Regulator Co, 1603 S Michigan Ave, Chicago, Ill. 4-page bulletin No. 111 describes the Transometer, which employs a positive displacement method of measuring and controlling flow.

77 **LIQUID FLOW**—Fischer & Porter Co, Dept 6G6, Hatboro, Pa. Catalog insert 15-A covers a metering tube with no float guide rods. Price lists for different models are incorporated.

78 **TACHOMETERS**—Herman H Sticht Co, Inc, 27 Park Place, New York 7, N. Y. Bulletin No. 798 covers stationary tachometers in dial sizes of 8, 10 and 20 in. dials. A very large photo of meter face and cross-sectional drawings of flexible shaft drive complete the bulletin.

79 **VIBROMETER**—The Vibroscope Co, 6 East 39th St, New York 16, N. Y. Bulletin RH describes construction, uses, application of vibrometers.

80 **LEVEL INDICATORS**—Bijur Lubricating Corp, Long Island City 1, New York. 4-page bulletin No. 4B shows several installations and gives tables of specifications for certain types.

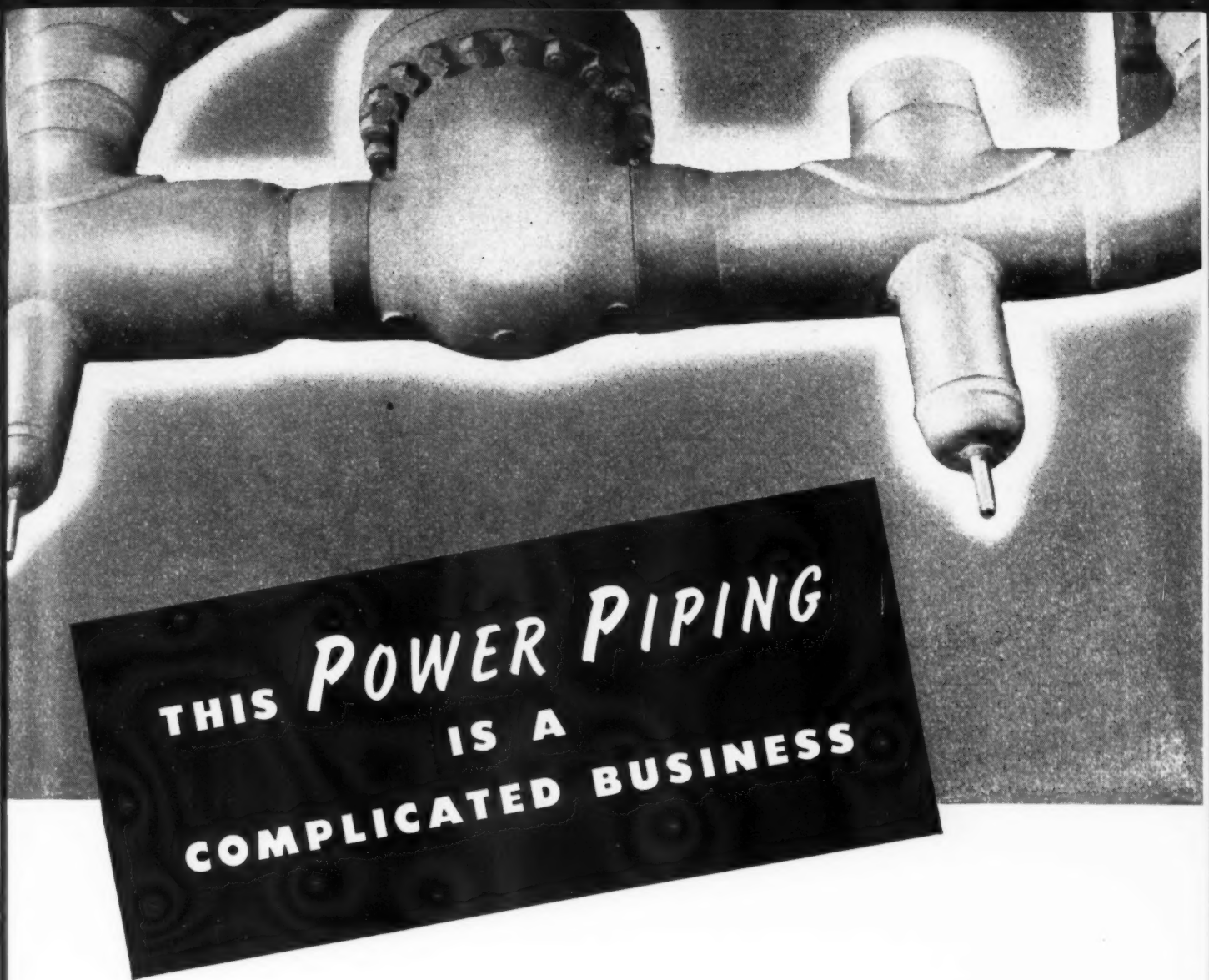
81 **TACHOMETERS**—Bristol Co, Waterbury 91, Conn. 12-page bulletin No. S1400 gives company's line of tachometer recorders and indicators. Wiring diagrams, application data, with supplementary illustrations of instruments and magnetos, are featured.

82 **PORTABLE PYROMETER**—Wheelco Instruments Co, 847 W Harrison St, Chicago 7, Ill. 4-page bulletin No. D602-4 covers company's line of portable pyrometers and carries specifications for selection of extension holders, adapters and thermocouple tips.

METERS AND INSTRUMENTS, ELECTRIC

83 **RESISTANCE TESTER**—Ideal Industries, Inc, Sycamore, Ill. Single-page catalog No. 41-011 shows company's insulation resistance tester for ac or dc equipment and the instrument hooked up for testing a motor and a transformer.

84 **SPECTROMETER**—North American Philips Co, Inc, 100 E 42nd St, New York 17, N. Y. 8-page booklet No. R1041, entitled "The Geiger-Mueller X-ray Spectrometer," is a reprint of previously published material covering applications, specimen preparation and identification methods.



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Blaw-Knox Power Piping Division delivers the piping to the job in practicable subassemblies, heat treated or stress relieved when necessary, shop tested, accurately aligned, thoroughly cleaned and inspected. Thus unified Blaw-Knox responsibility follows the installation from the beginnings of the design through to erection.

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85 VOLTMETER—Apparatus Dept, General Electric Co, Schenectady, N. Y. 2-page catalog insert No. GEA 4574 pictures a vacuum tube voltmeter, lists its features, covers its operation.

86 GRAPHIC INSTRUMENTS—Esterline Angus Co, Inc, Indianapolis, Ind. 4-page bulletin No. 242 describes many applications of graphic instruments in newer fields, air conditioning, radio, aeronautics to mention a few. Illustrations of certain applications and reproductions of recording charts portray role of the instrument in industry.

PIPING, FITTINGS, VALVES AND SPECIALTIES

87 EXPANSION JOINTS—MagniLastic Div, Cook Electric Co, 2700 Southport Ave, Chicago 14, Ill. 12-page catalog No. 267M, entitled "Expansion Joints," lists engineering data, dimension tables and specifications for packless and low pressure-large diameter expansion joints as well as for anchor joints.

88 MECHANICAL VALVES — William M Bailey Co, Pittsburgh, Pa. 6-page folder, entitled "Mechanical Goggle Valves," makes use of sectional drawings, equipment views and dimension tables to present company's line of these valves.

89 TUBE COUPLINGS—Parker Appliance Co, 17325 Euclid Ave, Cleveland 12, Ohio. 44-page catalog No. 201C covers company's line of tube couplings in its two broad types, standard or triple, and in both standard and heavy weights for normal- and high-pressure operation. In addition to specifications and equipment views, a net price appears for each item.

90 BLOWOFF VALVES—Edward Valve & Mfg Co, East Chicago, Ind. 16-page catalog No. 12-D divides line of blowoff valves into three pressure classes for ready indexing and reference. Design details, dimensions, specifications, manufacturing processes are described and pictured.

91 POWER - PLANT EQUIPMENT—Williams Gauge Co, 1620 Pennsylvania Ave, Pittsburgh 12, Pa. 24-page catalog No. 449 portrays company's line of power-plant equipment, including check valves, traps, water columns, water gages and gage cocks.

92 STEAM PIPING—Ric-Wil Co, Cleveland, Ohio. 10-page bulletin No. 4605 describes company's installation at the Piqua, Ohio, municipal power plant. Steam sales through external piping to nearby industrials is a feature of the bulletin.

PUMPS

93 MINE PUMPS—Marlow Pumps, Ridgewood, N. J. 4-page bulletin No. EM46 discusses design, construction materials, servicing of a mine-gathering pump.

94 ROTARY PUMPS—Viking Pump Co, Cedar Falls, Iowa. 8-page bulletin No. 46-S shows company's standard and heavy-duty rotary pumps. Information is furnished on specifications, installation construction of these units with full and cutaway views of principal ones.

95 VACUUM PUMPS—Kinney Mfg Co, Boston 30, Mass. 38-page bulletin No. 18A, entitled "Liquid and Vacuum Pumps," covers principal parts, operating theory, uses, features of company's line of pumps. Tables of specifications, sectional drawings and a recommendation table for pump applications help present this material.

96 CENTRIFUGAL PUMPS—Ingersoll Rand Co, 11 Broadway, New York 4, N. Y. 16-page bulletin No. 7062 describes a 2-stage ball-bearing pump, available in capacities up to 2200 gpm, for discharge heads up to 450 psi. Cutaway views, types of drives, installations, performance tables, dimensions and pipe friction, and a typical pumping problem appear in this bulletin.

97 VOLUTE PUMPS—Warren Steam Pump Co, Inc, Warren, Mass. 4-page bulletin No. 229 discusses company's volute centrifugal pump, Type 2HB. It gives mechanical features, specifications, sizes, capacities and dimensions.

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WITH

NICHOLSON EXPANSION TRAPS

Featuring easy installation (usually without need of supports) and low cost, Nicholson expansion steam traps make it practical to trap all individual units—and thus speed heat transfer and production. For details, Catalog 444.

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1. Adjustable for any pressure to 250 lbs. without changing valve or seat.
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3. Entirely automatic action.
4. Quiet, continuous discharge.
5. Discharge air as efficiently as water.
6. Wide open when cold.
7. No air binding; no freeze-ups.
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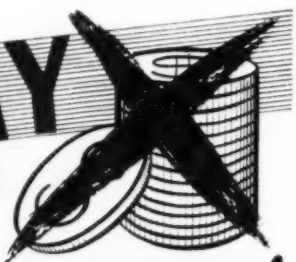
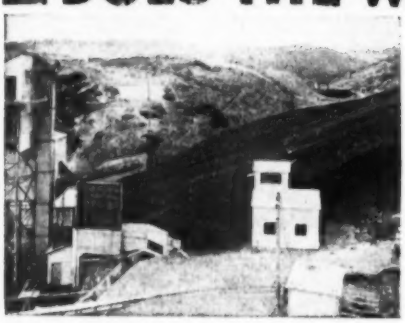
1 $ECONOMY with SAUERMAN



1 DOES THE WORK OF MANY!



Laguna Verde generating station, one of Chile's largest steam power plants, handles its reserve supply of coal with a Sauerman Scraper System which has to meet somewhat unusual requirements.

Plant is located in valley between mountains and ground available for storage pile is sloping and uneven. It is necessary to store about 25,000 tons of coal every three months and to reclaim at 90 metric tons per hour.

A 3 cu. yd. Sauerman Scraper, operating uphill on a 350 ft. span, using high backposts to support the tail bridle, meets every requirement. Full capacity of scraper is not needed for reclaiming, but is necessary to take care of the heavy storage demands.

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SAUERMAN SCRAPER SYSTEM

Hundreds of plants, using Sauerman Systems, are securing better utilization of space, reducing costs of storing and reclaiming coal to only a few cents per ton, and doing a better, cleaner, and safer job.

A Sauerman machine builds a compact and homogeneous pile that minimizes combustion hazards. There is a size and type of Sauerman System to meet your specific requirements. Installation and maintenance costs are surprisingly low.

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562 S. CLINTON ST., CHICAGO 7, ILLINOIS

POWER SLUSH PUMP—National Supply Co, P O Box 899A, Toledo 1, Ohio. 16-page bulletin No. 321, entitled "Power Slush Pump, Type C-250," gives general and special features, a performance chart, specifications, illustrations and a blueprint.

WELDING

99 CLEANING WELDS—Chicago Mfg & Distributing Co, 1928 W 46th St, Chicago 9, Ill. 16-page booklet, entitled "How to Clean Welds," by Thomas I. Adas, covers all phases of weld cleaning and provides instructions for these operations.

100 WELDED STRUCTURES — Engineering Experiment Sta, University of Illinois, Urbana, Ill. Bulletin No. 361, "Residual Stresses in Welded Structures," includes an analysis of theories of residual stress, reports on tests performed on welded seams under load, circular welded seams under static load and longitudinal butt welds under fatigue.

101 WELDING CONTROL—Apparatus Dept, General Electric Co, Schenectady, N. Y. 12-page bulletin No. GEA-4571 discusses importance of control in resistance welding, the role of electronic contactors, timing of current, adjustment of current magnitude, and control combinations and devices.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **WELDING ELECTRODES**—Metal & Thermit Corp, 120 Broadway, New York 5, N. Y. 92-page catalog lists applications, characteristics, properties and welding procedures for over 40 Murex arc welding electrodes. A table for planning and estimating welding job cuts is included.

102 ROD SELECTION—Eutectic Welding Alloys Corp, 40 Worth St, New York 13, N. Y. Large, 18x23 in. chart on welding rod selection lists company's products, suggested applications and engineering data.

OTHER EQUIPMENT

103 RIVETED JOINTS—Engineering Experiment Sta, University of Illinois, Urbana, Ill. Bulletin No. 360, entitled "Investigation of the Strength of Riveted Joints in Copper Sheets," points out ways in which a riveted joint connecting copper sheets may fail. Tests described are made to determine strength against these failures.

104 PROCESS INDUSTRIES — Allis-Chalmers Mfg Co, Milwaukee 1, Wis. 16-page booklet No. 25B6177B contains a series of sketches to serve as buying aids in preliminary selection of motors, controls, power equipment, screens, crushers, grinders, electronic heating and welding equipment.

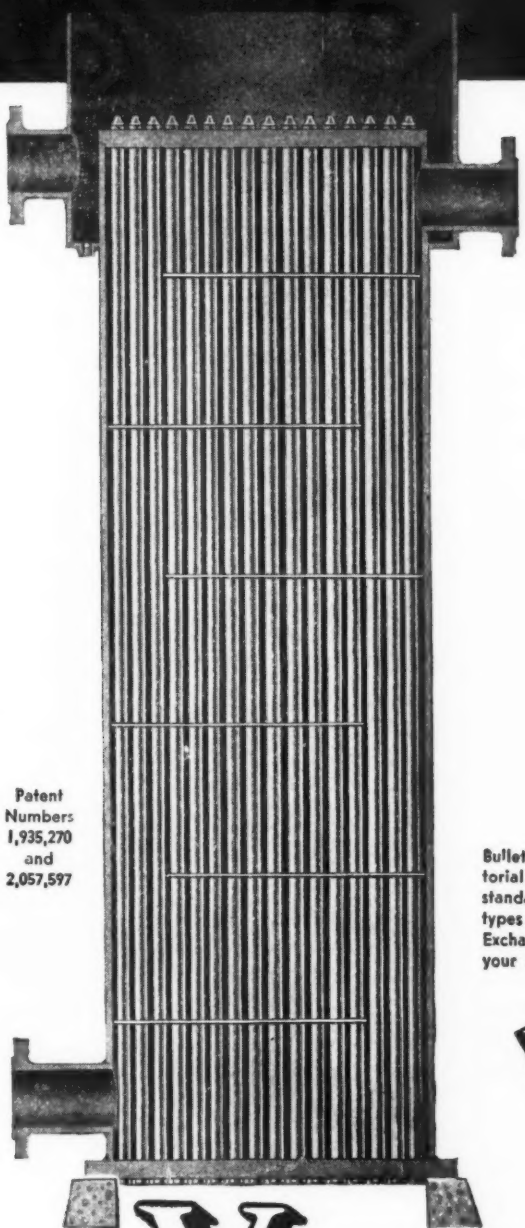
105 WATER TREATMENT—Permutit Co, 330 W 42nd St, New York 18, N. Y. Booklet describes a master valve control for gravity and large size pressure filters or zeolite softeners.

106 HEAT INSULATION — Magnesia Insulation Manufacturers Association, 1317 F St, N W, Washington, D. C. 4-page MIMA News, published by the Association members, Philip Carey Mfg Co, Ehret Magnesia Mfg Co, Johns-Manville Sales Corp, Keasbey & Mattison Co and Plant Rubber Asbestos Works. Publication, covering news, research and application of magnesia products, will appear quarterly.

Federal Power Commission announces that East Ohio Gas Co, Cleveland, O., has been authorized to construct and operate a 144-mi pipeline extending from Hope Natural Gas Co's outlet at the Ohio-West Virginia state line to the outskirts of Cleveland. Cost is estimated to be $4,620,000.

FILM TYPE EXCHANGERS

DETAIL SHOWING DISTRIBUTING FERRULE IN TUBE (Patent Pending)



Patent Numbers 1,935,270 and 2,057,597

Vogt engineers have taken a familiar refrigeration plant "old timer" and developed it into this modern, efficient heat exchanger.

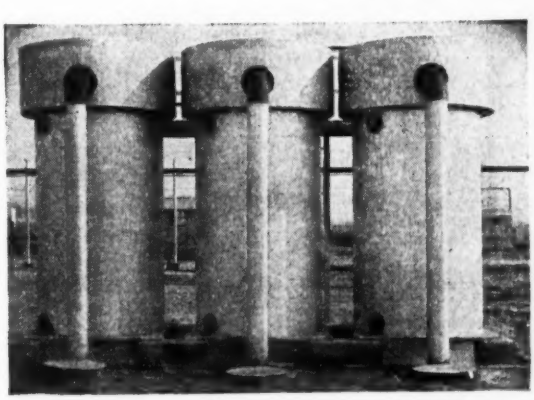
The film type exchanger operates in a vertical position. Water introduced in the top chamber is distributed in a thin film against the inner tube walls by means of special ferrules. The shell side of the exchanger has baffles arranged to provide optimum velocities, pressure drops, and heat transfer rates. Shutdowns are eliminated because tubes can be cleaned while the unit is in operation; thus permitting the use of dirty, mud and silt depositing water.

Vogt Film Type Exchangers now serve as Jacket Water Coolers, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to condense any vapor. They are also applicable for handling liquids other than water in film flow.

HENRY VOGT MACHINE CO., INC.
LOUISVILLE 10, KENTUCKY

Branch Offices: New York, Philadelphia, Cleveland, Chicago, St. Louis, Dallas

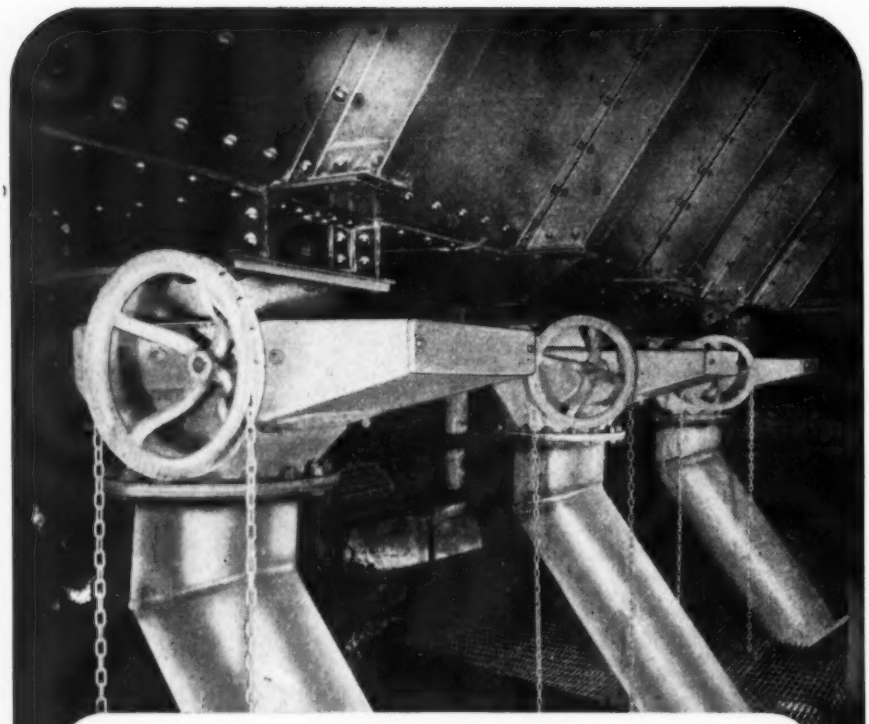
Bulletin HE-5 is a pictorial presentation of standard and special types of Vogt Heat Exchangers. Write for your copy.



Jacket Water Coolers serving engines of 7,300 H.P. Muddy well water used as cooling medium.

Vogt

HEAT TRANSFER EQUIPMENT

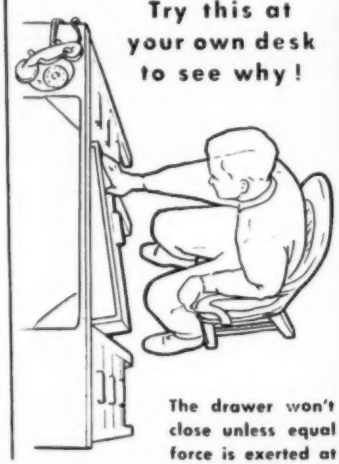


The gate in a
S.E. Co. COAL VALVE
always closes square

The center drawer of your desk provides a clear demonstration of the factors that prevent sticking or binding of the gate in the S. E. Co. Coal Valve. Just as the desk drawer will stick if you try to close it in the manner shown in the illustration, a coal valve gate will bind unless some means are provided to keep it straight and propel it squarely. Twin racks and pinions do the job in the S. E. Co. Coal Valve, keeping the gate in perfect alignment and providing square opening and closing all the way at all times.

Write for descriptive illustrated bulletins. Address The Stock Engineering Co., 715 Hanna Bldg., Cleveland 15, Ohio

Try this at your own desk to see why!



The drawer won't close unless equal force is exerted at both edges.

STOCK ENGINEERING CO.

★ CONICAL Non-Segregating Coal Distributors ★ S.E.CO. Coal Valves and Coal Scales

APPOINTMENTS

Allison div, General Motors Corp, announces formation of a transmission engineering dept with R E Lynch as manager.

Concurrent with the occupancy of its new building in Detroit, **Wm F McGraw & Co** made public the acquisition of Glenn Cogsdill as service engineer and Al J Rosborough as sales manager.

Appointment of Vice Admiral Harold G Bowen, USN, as chief of the newly established **Office of Naval Research** was confirmed by John W Kenney, Assistant Secretary of the Navy; at the same time confirmation was made of Rear Admiral Luis de Florez as assistant chief of the office.

Arthur A Crafts Co, Boston, Mass., has become an authorized distributor for Carboloy Co, with Roger N Huston, vice-president of Arthur A Crafts Co, as head of the new operation, the manufacturer announced.

Graduate School, **Illinois Institute of Technology,** selected Dr William A Lewis, Jr, formerly research professor at the institute, to succeed Dr Linton E Grinter as dean. Dr Grinter resigned his administrative duties to concentrate on his work as research professor of civil engineering.

Appointment of two new sales representatives and a new district office has been announced by **Ward Leonard Electric Co.** The new office is at Boston under Kasson Howe as district manager. L F Church Co, San Francisco, and Marvin H Kirkeby, Minneapolis, are the sales representatives.

Combustion Engineering Co has organized a new company, Combustion Engineering de Mexico, S. A., to provide sales, technical and installation service for its complete line of products in Mexico. George C Seifert, vice-president and general manager and Seldon Merrill, manager of installation, are resident executives.

John ' Lawton, former **Graybar** sales manager at Seattle, moves up to district manager of the company's Northwestern district with headquarters at Seattle, the president, A H Nicoll, announced.

The new hydraulic division, **Rockwell Mfg Co,** will be headed by W H Marsh as general manager.

Roy E Couch succeeded O L Applegate as plant engineer for Cincinnati branch of **Standard Brands, Inc.**

Bausch & Lomb Optical Co has established a joint concern, Aga Bausch & Lomb Ab, with the Swedish corporation Aga-Baltic Ab, to serve Sweden and Finland.

Robert L Spencer has been appointed patent attorney for **Crosley Corp,** announces R C Cosgrove, vice-president and general

Performance plus

CLASS 9001 TYPE TY
Surface Mounting, Oil-Tight
Pushbutton Station

with SQUARE D OIL-TIGHT Pushbuttons

• Square D's line of oil-tight units is now available in surface mounting, oil-tight enclosures for 1, 2, 3, or 4 units. The features which have made these units the predominating choice for built-in applications, are just as valuable in these surface mounting enclosures.

Proven oil-tight and coolant-tight by severe tests involving millions of operations.

Very compact units permit small enclosures with generous wiring space.

Flexibility. Pushbuttons, selector switches and pilot lights can be assembled in a wide range of combinations. Legend plates can be positioned for either vertical or horizontal mounting.

Attachments for lock-out and maintained contact operation, mount on standard units.

Wherever electricity is distributed and controlled

SQUARE D COMPANY

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FIRE STOPPING POWER

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FIRE EXTINGUISHERS

Greatly increased fire-killing capacity.

Simplified operation.

Expert performance by inexperienced operators.

Quick, easier on-the-spot recharge after use.

More fire stopping power pound for pound, dollar for dollar.

Greater heat-shielding protection for operator.

Increased fire-fighting capacity without increased weight.

Engineered to resist corrosion.

Install the NEW Ansul-Dugas Extinguishers at all hazard spots for greater protection against all fires involving flammable liquids, gases and electrical equipment.

Ready... in a Flash!

- Simply remove ringpin and push lever down.

- Open nozzle and direct chemical stream at base of flames.

53% More...

FIRE STOPPING POWER

with the NEW FASTER ACTING

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FIRE EXTINGUISHERS

Write today for new catalog and authoritative data showing characteristics of all types of approved hand fire extinguishers.

Listed and Approved by Underwriters' Laboratories and Factory Mutual Laboratories.

ANSUL CHEMICAL COMPANY
FIRE EXTINGUISHER DIVISION • MARINETTE, WIS.

manager of manufacturing division. Spencer succeeds A D Redfield who becomes patent attorney with Aviation Corp, the parent organization.

Announcement has been made by Dr L A Pratt, general sales manager, **Monsanto Chemical Co,** Merrimac division, of the appointment of F F Ogden, manager of special products sales development and J J McCarthy, manager, chemical sales development.

Leon A Watts, general superintendent, service and erection, **Allis-Chalmers Mfg Co,** announced the naming of Irwin McNiece as assistant district superintendent, service and erection, Los Angeles.

Aireon Mfg Corp through R C Walker, president, announced that Kenneth D Halleck has been appointed vice-president and Bernard D Craig, vice-president and director.

Manager of sales for fabricated plate division of **Graver Tank & Mfg Co, Inc,** will be W M Broxham, former manager, Philadelphia office.

Appointment of Paul J Stein, as sales representative for Taylor and A E Stokers in western Pennsylvania, eastern Ohio and northern West Virginia, has been announced by **American Engineering Co.**

Representative for **Automatic Control Corp** in the New York territory is R F Goodwin.

A newly created Coal Heating Service division of the **National Coal Association** has as its manager J Nelson Stuart, according to a recent announcement by John D Battle, executive secretary.

Erle J Zoll has been named president of **Chicago-Wilcox Co.** He has been associated with the company for 29 years in sales work.

Formation of **Taco Engineering Co,** consulting, designing and manufacturing organization for electronic and electromechanical automatic-control equipment, has been announced by T A Cohen, its founder.

New York Belting & Packing Co has selected Geo C Deverall as sales representative for New England, New York, New Jersey and eastern Pennsylvania. Walter E Belcher, manager of Dallas district, has been retired after 51 years' service. His successor is his former assistant, J E Conway.

Representative of **Colonial Broach Co and Colonial Bushings, Inc,** in Texas, will be David C Crowley, Houston, Ralph G Lagerfeldt, vice-president in charge of sales, has announced.

L M Benkert, sales manager of **Progressive Welder Co,** announces the following appointment in handling the company's line of resistance-welding equipment: K P Swanson, representative in eastern

7 reasons..

WHY LEADERS IN EVERY FIELD CHOOSE THE ELGIN WATER SOFTENER

1 DELIVERS 44% MORE SOFT WATER
In comparison with other zeolite water softeners the Elgin delivers as much as 44% more soft water.

2 LOWER INVESTMENT
Based on cost per thousand gallons of soft water delivered, the Elgin Water Softener is far lower in price.

3 LOWER OPERATING COST
By virtue of an improved distributing and collecting system, less regenerating salt and wash water are required.

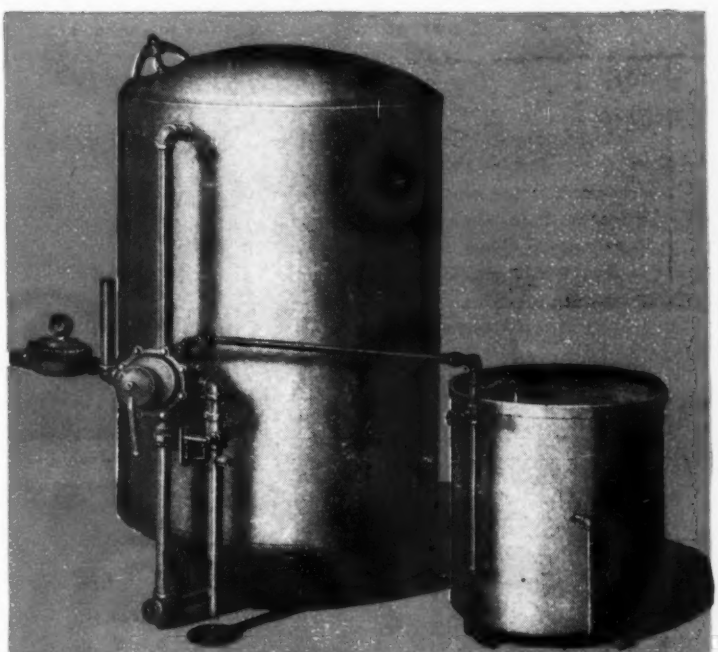
4 HIGHER EFFICIENCY
The water softening zeolite in the Elgin is kept clean and active so that equipment operates more efficiently without attention—and mofe "zero-soft" water is delivered per pound of salt used.

5 LESS MAINTENANCE
Unbiased surveys prove that with ELGIN quality construction throughout, fewer replacements are required. Loss of zeolite is prevented, thus eliminating costly additions.

6 LONGER LIFE
Efficient distribution, collection and regulation of water and brine add years to the life of Elgin Water Softeners.

7 LESS SPACE REQUIRED
To give the same capacity as an Elgin, other water softeners must be as much as 50% larger in size.

Existing water softeners of any make can be modernized by Elgin to provide the above features.



Latest design Elgin Water Softener

THE ELGIN WATER SOFTENER gives greater capacity and higher efficiency because it accommodates a far greater quantity of water softening zeolite—and uses it more effectively by virtue of an ingenious manifold system and backwash regulator. Naturally, a greater volume of soft water is delivered because it's the zeolite that softens water—and more zeolite used with greater effectiveness means more softened water.

A NEW BULLETIN . . .

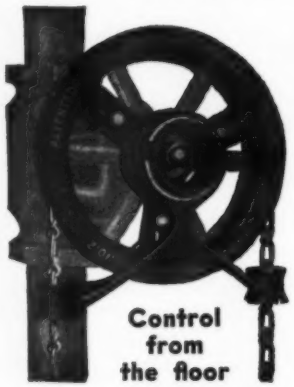
So important are these features to the users of soft water that we have prepared a new factual bulletin describing the construction and operation of the postwar Elgin Water Softener and explaining the benefits and economies of softened water. Ask for Bulletin 607. For hospitals it's Bulletin 608. For laundries it's Bulletin 609.

ELGIN SOFTENER CORPORATION

130 NORTH GROVE AVENUE, ELGIN, ILLINOIS

SOFTENERS ★ FILTERS ★ WATER TREATMENT ★ BOILER WATER CONDITIONING

Make Your Overhead Valves SAFE and Easy to Reach---



With the Babbitt Rim for Valves you eliminate danger and banish the step ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

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New Bedford, Mass.

IMO— The PREFERRED PUMP for OIL BURNERS

IMO pumps provide the steady, pulsation-free delivery conducive to a steady flame and efficient combustion.

The IMO is a positive displacement rotary pump of unique design having no pistons, valves, sliding vanes, or intermeshing gears to cause intermittent delivery.

For further information send for bulletin I-137-P

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ELEVATOR ROPES
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Safe, economical Macwhyte Elevator Ropes are made from selected steels best for elevator hoisting. Wire is drawn in our own mill specially for Elevator Ropes. Macwhyte Ropes are given flexibility to withstand bending fatigue, yet stretch is held to a minimum. Available PREformed or Non-PREformed. Carried in stock by Macwhyte Distributors and Mill Depots.
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Makers of the correct ropes
for your equipment
MACWHYTE COMPANY
50th Year
1896 - 1946

Connecticut, eastern Massachusetts, Rhode Island, Maine, Vermont and New Hampshire, who will join with V A Chern, representative New York metropolitan district, western Connecticut and western Massachusetts, and H B Axtell, eastern New York and northern New Jersey representative.

Polytechnic Institute of Brooklyn announced establishment of a new post, administrator of research, through its president, Dr Harry S Rogers. The post will be filled by Howard P Wile, formerly with Radiation Laboratories and Research Laboratories, Massachusetts Institute of Technology.

F B Ennis, manager of manufacturing, Bridgeport division, **General Electric,** has announced appointment of C A Lindemann, supervisor of planning and methods in the wiring-device division.

John A Scanlon Supply Co, industrial boiler sales and steam apparatus, has resumed business with the return of its two officials, John A Scanlon, formerly lt commander, USNR, and chief warrant officer, Paul O Saltarelli.

Ralph R Newquist has been elected vice-president, in charge of sales, **Roots-Connersville Blower Corp** has announced.

International Nickel Co, Inc, announced the opening of the Texas Technical Section, Development and Research Division, under the direction of R J Rice, metallurgical and chemical engineer.

Chief hydraulic engineer, **Infilco, Inc,** will be A A Kalinske, formerly consultant, research director and professor, in sanitary engineering at University of Iowa.

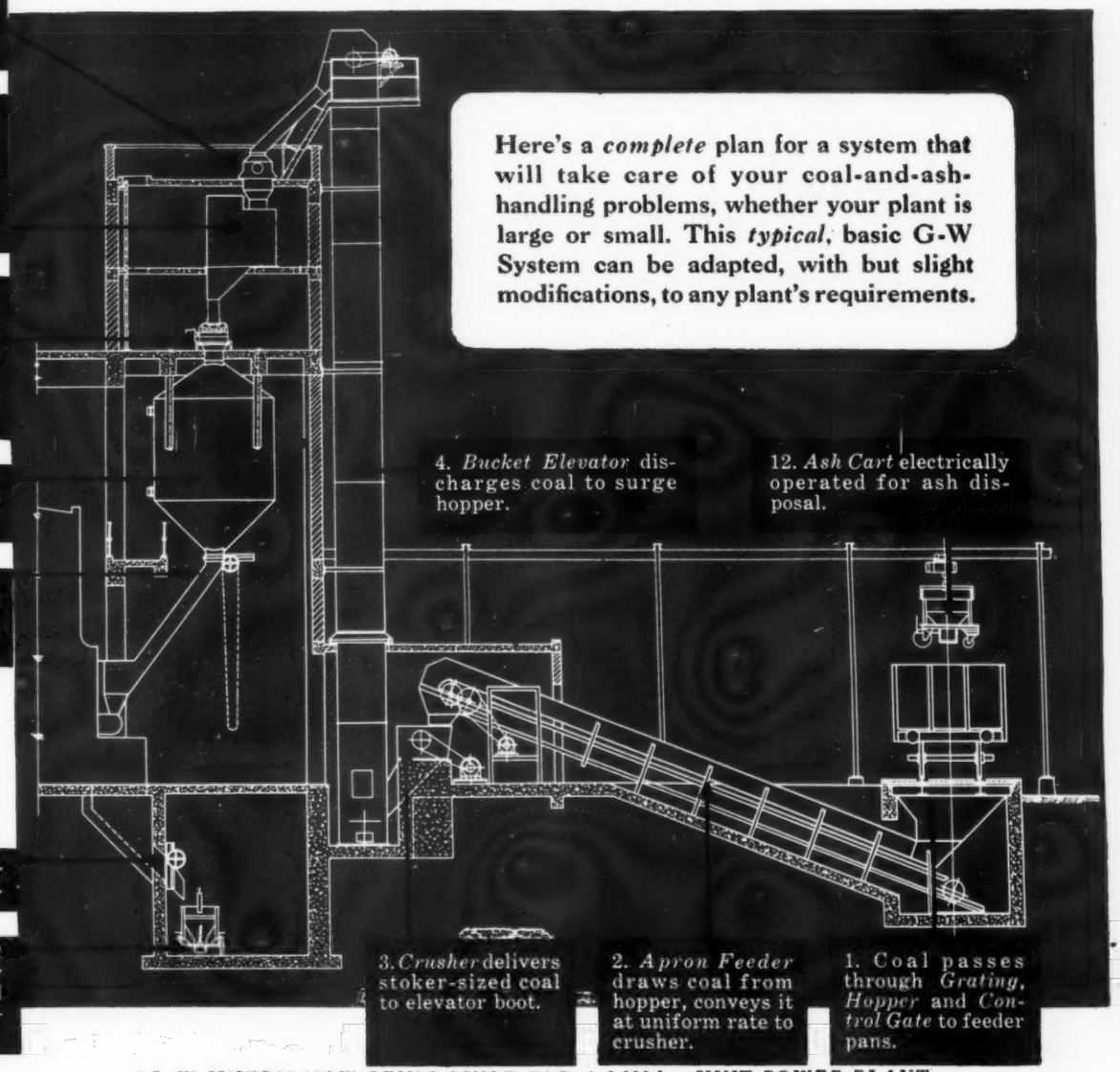
Westinghouse Electric International Co has announced through its president and general manager, W E Knox, the appointment of D C Lynch as assistant general manager. Robert Russell, formerly assistant manager of the special projects dept, takes over the now vacant post of manager.

Additional sales offices and expanded sales force have been announced by **Reliance Electric & Engineering Co** with the following personnel involved: George E Law, Minneapolis, to head the Appleton, Wis., office; N J Sandling, western Michigan, to head the Grand Rapids office and have as his assistant, W F Cliff, electrical application engineer; W K Schlotterbeck, to rejoin the Philadelphia office; E H Koontz, Minneapolis, to join New York office; R L Custis, also to New York, D M Larson to Minneapolis, A C Perrin to Chicago, and Albert Mann to Detroit.

Appointments of F C Rodgers, general manager, fire division, and H V Williamson, director of research, have been announced by **Cardox Corp.**

Four promotions announced by Spang-Chalfant division, **National Supply Co** are, according to G E Clifford, vice-presi-

This *one* basic blueprint* solves *all* problems in coal-and-ash-handling


5. Surge Hopper Control Unit assures constant supply to scale.
6. Scale automatically weighs, records and discharges to shuttle belt conveyor.
7. Shuttle Belt Conveyor serves several bins from central weighing point.
8. Storage Bins have coal level control.
9. Control Gate and Spout to stoker.
10. Ash Unloading Gate.
11. Ash Cart manually operated through tunnel.
Here's a complete plan for a system that will take care of your coal-and-ash-handling problems, whether your plant is large or small. This typical, basic G-W System can be adapted, with but slight modifications, to any plant's requirements.
4. Bucket Elevator discharges coal to surge hopper.
12. Ash Cart electrically operated for ash disposal.
3. Crusher delivers stoker-sized coal to elevator boot.
2. Apron Feeder draws coal from hopper, conveys it at uniform rate to crusher.
1. Coal passes through Grating, Hopper and Control Gate to feeder pans.

*G-W SYSTEM NOW BEING BUILT FOR A 2,000 kw. UNIT POWER PLANT.

COAL IN... ASHES OUT

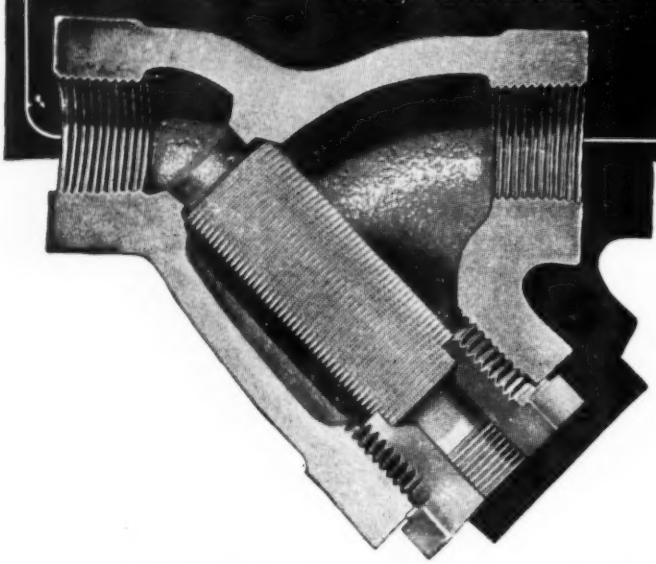
HANDLING HEADQUARTERS
for Industrial Conveying and Elevating Equipment . . . for Infra-Red Baking and Drying Equipment . . . for Ice Handling Tools and Ice Processing Machines.

G-W HANDLES IT...
faster • easier • cheaper

G-W will do the complete job. From start to finish G-W shoulders full responsibility for all details of design, manufacture, and erection. You save the time and money usually spent in dealing with sub-contractors. Two-way assurance that G-W will install the coal-and-ash-handling equipment that's best for your plant: hundreds of satisfied G-W equipment users; more than 130 years' experience in designing material-handling equipment for all types of industries. Gifford-Wood Co., 420 Lexington Ave., New York 17, N. Y.; 565 W. Washington St., Chicago 6, Ill.—Factory: Hudson, N. Y.

GIFFORD-WOOD
SINCE 1814

It says "STOP" to Solids— "GO" to Fluids



A BETTER Strainer to "police your pipelines"

• **FIRST**—*The Screen*, a high-grade woven Monel wire basket that catches solids—lets condensate, oil or other fluids flow freely.

• **SECOND**—*Finish*. Cadmium plated for protection against corrosion and for better appearance.

• **THIRD**—*Easily Cleaned*. Blow-off bushing made for easy removal. Bushing and Screen come out together. Screen automatically aligns on reassembly.

• THOUSANDS IN SERVICE—Sold by over 100 Mill Supply Houses.

6 sizes from ½" to 2" for pressures up to 600 lb. Reasonably priced. See your supply house or write for Bulletin S-201.

YARNALL-WARING COMPANY
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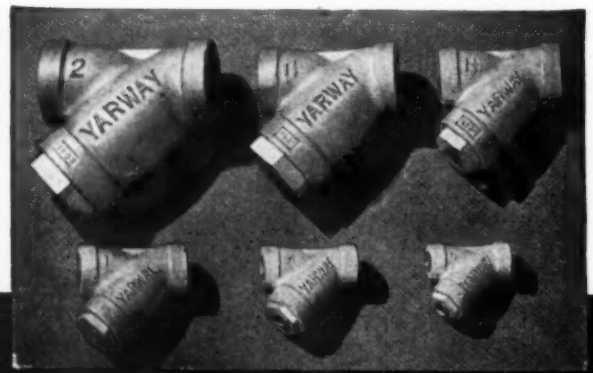


YARWAY STRAINERS

dent: (1) and (2) C J Ramsburg, Jr, Eugene F Conroy, assistant managers, New York office (3) Edwin A Booth, Pittsburgh district manager (4) Frank W Morris, Tulsa district manager.

Carl M Lynge, general works manager, Bridgeport, Conn., plant of **General Electric** announced the promotion of M W Reid, superintendent of machine and tool section, to assistant general manager, and of G F Kelley, assistant superintendent of machine and tool section, to manager of that section.

A board of directors meeting elected J E Allen, vice-president, to be executive vice-president, **Aro Equip Corp,** according to J C Markey, president.

OBITUARIES

B V E Nordberg, 62, executive engineer, Nordberg Mfg Co, Milwaukee, Wis., died Aug. 19. His father, the late Dr Bruno V Nordberg, was founder of the company.

Philips Payson Bourne, 75, formerly chief engineer of Cambridge, Mass., plant of Worthington Pump & Machinery Corp. died on Aug 26 at Foxboro, Mass.

Richard Parry, 75, retired power engineer and power-plant consultant, died Aug 20 in Dayton, O. He was past national president of National Assn of Power Engineers.

Harold P King, chief powerhouse engineer, General Motors Co, Rochester, N. Y., died Aug 16.

Seymour M (Mark) Jenkins, 54, insulating brick salesman, New York, for building materials div, Armstrong Cork Co, died Aug 13 in New York City.

Mechanical Production Aids Feature Show

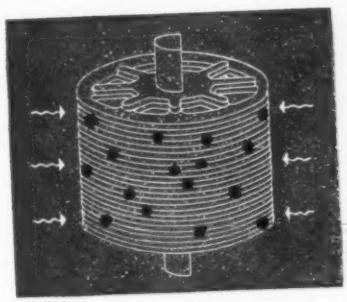
Three hundred anticipated displays at the Fourth All-Industry Refrigeration and Air Conditioning Exposition, Cleveland, Oct 29-Nov 1, will disclose industrial applications of new equipment in the refrigerating field. These applications include (1) low-temperature treatment of steel to increase its strength and ductility (2) chilling of assembly parts to speed up production, for example, of an automobile manufacturer who uses refrigeration equipment to shrink steel-valve inserts for permanent fitting into cylinder blocks at a rate of 360 per hr (3) cooling of lenses in the optical field to remove pitch (4) sub-zero temperature control of frozen rubber to permit easier machining.

Air conditioning has increased its value to the manufacturing-process end of industry as the following cases demonstrate: Humidity control and air cleanliness aid watch manufacturing. food processing. Temperature and humidity control in a printing plant reduces spoilage of lithograph plates and saves time in seasoning.

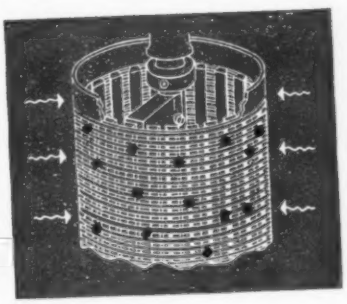
Cleaning the Fluid

IS AS SURE AS THIS

Full Flow Filtration — Every Drop Gets Challenged



AUTO-KLEAN. Fluid passes between metal discs. Solids larger than opening collect on outside.

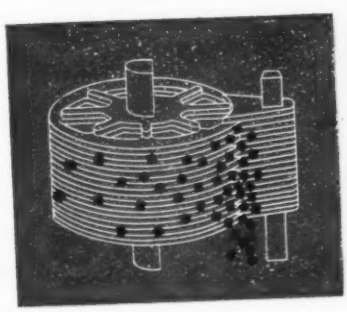


FLO-KLEAN. Fluid passes between wires. Solids larger than opening collect on outside.

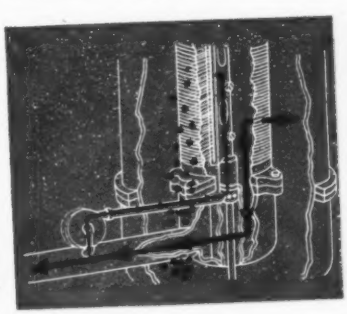
Cleaning the Filter

IS AS EASY AS THIS

Continuously Cleanable — without Stopping Flow



AUTO-KLEAN. Rotatable discs turn past stationary cleaner blades which comb out accumulation.



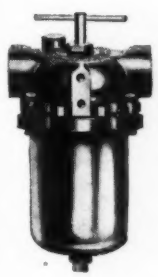
FLO-KLEAN. Motor-driven backwash system dislodges solids, which settle into sump.

Contamination doesn't have a chance with a Cuno Filter on the job. Cleaning is positive and continuous. One unit, no larger than usual partial-flow type, handles full flow. And there's no interference with flow when cleaning the filter.

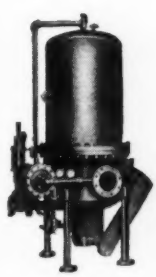
AUTO-KLEAN filter can be easily built-in or externally mounted on your machine. And either Cuno filter — AUTO-KLEAN or FLO-KLEAN — will save you the space and expense of a duplex installation.

Filter cleaning is simple . . . AUTO-KLEAN by turning an external handle, with hand or motor . . . FLO-KLEAN by motor-driven backwash system. Nothing to remove or renew.

The Cuno catalog in SWEET'S tells which Cuno model is best for your requirements — or send for complete catalog (use coupon). Cuno's engineering staff will also help you on special conditions.



AUTO-KLEAN *disc type.* For all fluids except those containing highly abrasive solids. Viscosities from 30 to 50,000 Saybolt seconds. Minimum pressure drop. Continuously cleanable by turning a handle (manually or automatically). Occupies no more space than usual partial-flow type. Sizes range from cartridges as small as 1¼" diam. x ⅞" length to massive motor-driven models. Available with or without sump for built-in or external installations.



FLO-KLEAN *wire-wound.* For fluids containing highly abrasive solids such as metal chips, abrasive wheel particles, sand, etc. May be designed to remove particles .0025" or larger. Continuously cleaned by backwash system. Low pressure drop — fluid moves in straight line, encountering only momentary restriction. All parts made of metal — constructions to meet varying corrosive and erosive conditions.

KEEP FLOW ON "GO" WITH

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ENGINEERED FILTRATION

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☐Acids
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☐Boiler Feed
☐Casein
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☐Coatings
☐Compressed Air
☐Coolants
☐Cutting Oils
☐Dip Tank Systems
☐Enamel
☐Engine Fuel
☐Engine Lubricating Oil
☐Fuel Oil
☐Fuel Tar
☐Gases
☐Gasoline
☐Grease
☐Grinder Coolant
☐Hydraulic Oil
☐Japan
☐Lacquer
☐Lubricating Oil
☐Machine Tool Cutting Oil
☐Machine Tool Hydraulic Oil
☐Machine Tool Lubricating Oil
☐Nitrocellulose Solutions
☐Oils
☐Paint
☐Pyroxylin
☐Quenching Oil
☐Resins
☐Rust-Proofing Compounds
☐Sizing
☐Solvents
☐Spray Systems
☐Tar
☐Test Stand Lubricating Oil
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THE PACKING for EVERY PURPOSE

Stops Leaks *Prevents Scoring*

ALLPAX

This universal packing—consisting of long, tough fibrous asbestos fibres, thin flakes of anti-friction metal, minute graphite scales and a heat-proof lubricant — is recommended for general service against steam, water, air, ammonia, oils, gases, etc. where temperatures do not exceed 600°F. Fits all sizes and shapes of stuffing boxes. Special styles available for high temperature and corrosive liquids, for products, etc. Try it and you'll use it regularly.

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A 48-page special section on Boilers and Steam Generators

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Yes . . . a wonder valve. For the LUDLOW Multi-Valve gives throttling action and positive shut-off with reliable and long-lived performance!

Accurate throttling action results from an ingenious multi-staging of the cone-shaped plug by which pressure is reduced step by step in a series of annular expansion chambers. Positive shut-off is assured through the multi-contact lands seating firmly against the converging walls of the seat. Cone is mounted rigidly on a non-revolving stem that operates with a straight push-pull action . . . gives longer packing life. The valve requires no regrinding.

LUDLOW Multi-Valves are built to meet modern needs. Write for Bulletin 103.

The **LUDLOW VALVE** SINCE 1866

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LOW COST DEMINERALIZED WATER

WILL REPLACE EXPENSIVE DISTILLED WATER IN THE MAJORITY OF APPLICATIONS

★ Demineralized Water suitable for many requirements demanding distilled water, can now be obtained at a fractional part of the cost of distillation. Belco deliveries are surprisingly rapid.

MODERNIZE YOUR ZEOLITE WATER SOFTENERS

The new Belco zeolite will increase the capacity of industrial softeners up to six times as much. Ideally suited for modernization of present equipment. Belco engineers are always available to help you.

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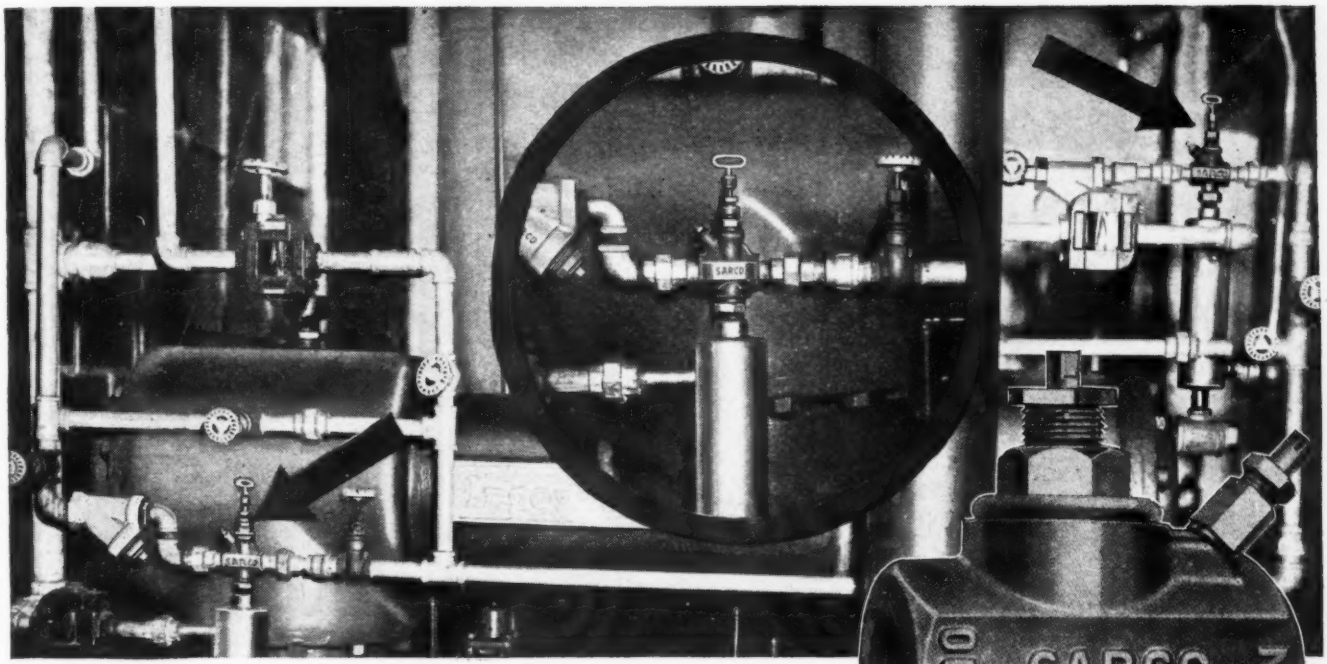
CHECK WITH BELCO...first!

Belco

INDUSTRIAL PROCESSING EQUIPMENT SINCE 1892



LESS WATER-LESS OIL-CLEAN AIR

and Greater Compressor Efficiency

TR 40 COOLING CONTROL

Sarco TR-40 Cooling Controls, applied to your air compressor, will save four ways, and it's a question which of these will prove most valuable to you.

Water consumption will be cut 25 to 50%. By preventing under-cooling, lubricating oil will be saved.

No burned oil can get into your air lines because overheating is definitely prevented. Correct jacket water temperature, automatically maintained, will increase compressor efficiency.

The TR-40 Cooling Control installed on the 3-story-high condenser shown at the right saved three-fourths of the water, increased the output and insured uniformity. It is used extensively on degreasers and food equipment and is frequently found as part of the original equipment. The cost is small—quickly recovered. Ask for Catalog No. 700.

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SARCO SAVES STEAM

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Represented in Principal Cities
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SARCO CANADA, LTD., TORONTO 1, ONTARIO

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LOVEJOY Flexible Coupling Co.
on
IDEAL Variable Speed TRANSMISSION

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"Select-O-Speed" Variable Speed
TRANSMISSION

Easily installed in line drive of old or new equipment. Correct speed by move of lever, for every condition. Speeds up or slows down instantly. Protects material, maintains precision, betters product. Infinite variability over wide range. *Low cost.* Used in thousands of plants.

Send for IDEAL Catalog

Also shows Variable Pulleys, Drive Sheaves, V-Belts, standard and wide, Adjustable Motor Bases, etc.

Mfd. by
LOVEJOY FLEXIBLE COUPLING CO.
Also Mfrs. of Lovejoy L-R Couplings
5070 W. Lake St., Chicago 44, Ill.

HERCULES
SEAMLESS COPPER
FLOATS
HERCULES

GUARANTEED
TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service. Insure carefree maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

OFF ON

Another Mercoid Advantage

(Illustration shows a Mercoid Pressure Control)

In the event of trouble in an electric circuit, the first thing a service man checks is the switch. He wants to know whether the circuit is open or closed.

In the case of a Mercoid control in the circuit a quick glance at the position of the mercury switch tells the story. Such information however, is not so readily available in other types of switches where the contacts are concealed from the direct vision.

Every service man appreciates the various conveniences and advantages of Mercoid Controls.

It should be noted that the Mercoid mercury switch is also a means of better control performance and longer control life. All contact trouble is practically eliminated.

If you have a control problem involving the automatic control of pressure, temperature, liquid level, mechanical operations, etc., it will pay you to consult Mercoid's engineering staff—always at your service.

Write for Catalog No. 600A. It contains a lot of control information.

MERCOID
AUTOMATIC CONTROLS
FOR HEATING, AIR CONDITIONING, REFRIGERATION, AND INDUSTRIAL APPLICATIONS
THE MERCOID CORPORATION, 4201 BELMONT AVE. CHICAGO 41, ILL.

PALMETTO *Pyramid*

The NEW Molded "Vee" Type Packing Engineers Have Been Looking For

Palmetto Pyramid is an all-purpose molded "Vee" type packing that seals firmly by mere finger-tightening. It is designed according to recently developed and thoroughly proven principles.

Performance of this much-talked-about packing is entirely automatic. Its sealing action is effected by internal pressure. *The greater the internal pressure—the tighter the seal!*

The unique "arrowhead reservoir"—one of the features of Palmetto Pyramid—actually stores and distributes the lubricant. Friction and wear are thereby appreciably reduced; packing and equipment life are substantially lengthened. *And*—look at the heavy wall construction!

Palmetto Pyramid is used for reciprocating as well as rotary motion. It is recommended for all types of hydraulic and pneumatic equipment handling hot or cold water, steam, oil, gasoline and most types of solvents and acids.

"IT PAYS TO KNOW YOUR PALMETTO PACKING DISTRIBUTOR!"

GT-1560

This coupon is for your convenience Mail it today!

GREENE, TWEED & CO.
New York 66, N.Y.

☐ Send descriptive literature covering PALMETTO Pyramid Packings

☐ Send PALMETTO representative to discuss packing

Name .....

Company .....

Street .....

City ..... *State* .....

GREENE, TWEED & CO.

Manufacturers of PALMETTO Packings

BRONX BLVD. AT 238th ST. NEW YORK 66, N. Y.

Plants at New York, N. Y. and North Wales, Pa.

Gives You

LONG, TROUBLE FREE SERVICE

Fig. 1635

"STANDCO"

PILLOW BLOCKS

The attractive "Standco" Pillow Block shown above is sturdily built and is offered in a wide range of sizes. Babbitted and broached bearing surfaces, accurately machined faces. Can be amply lubricated.

Write for Bulletin

"Unbrako" and "Hallowell" products are sold entirely through distributors.

Over 43 Years in Business

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA., BOX 577

Boston • Chicago • Detroit • Indianapolis
St. Louis • San Francisco

SCHERR

PRECISION INSTRUMENTS

For Close Reading

HAND TACHOMETERS

Measure rpm without timing or calculation while held against end of rotating shaft. Any variation in speed caused by belt slipping, overload, etc., is instantly noted. Also have disc for measuring surface speeds in feet per min. Made for speeds from 30 to 12000 changing speed range by new rotating shift mechanism. Other types to 48,000 rpm. Write for details.

SPEED INDICATORS

Gives direct readings in rpm in a test requiring only 6 seconds. Needle remains at reading until released by pressure of button. Also measures linear speeds using disc attachment. Two types, ranges to 20,000 rpm. Full data on this and other Scherr speed measuring instruments on request.

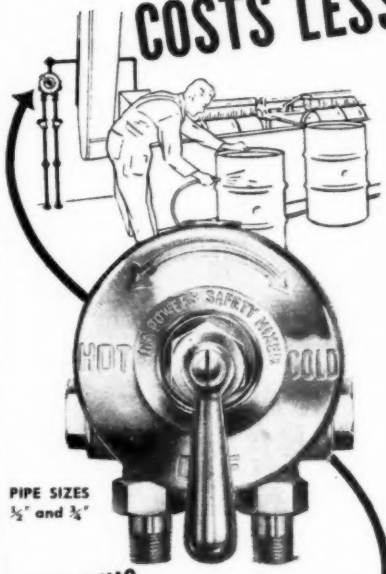
GEO. SCHERR CO., Inc.

196-A Lafayette St.
New York 12, N. Y.

POWERS

BEST KNOWN NAME IN WATER TEMPERATURE CONTROL

HOT WATER COSTS LESS



PIPE SIZES
½" and ¾"

WITH THIS STEAM AND WATER MIXER!

- Powers Type D Mixer gives you hot, warm or cold water at any temperature you want.
- Heats water in most economical way . . . mixes steam with cold or hot water. Heats only what you need when you need it.
- Easy to install. Can be used wherever a supply of steam and water is available at 10 to 100 lbs. pressure. Write for Circular 3013-B or phone our nearest office.

OFFICES IN 47 CITIES

WATER TEMPERATURE CONTROLS • 1 GAL TO 10,000 PER MIN

New York, 231 E. 46th St.
Chicago, 2771 Greenview Ave.
Los Angeles, 1808 W. 8th St.

THE POWERS REGULATOR CO.

OVER 50 YEARS
OF WATER TEMPERATURE CONTROL

SPECIFY OPEN STEEL FLOORING

for maximum light and ventilation!

Hendrick Mitco open steel flooring has rectangular openings that afford maximum light and ventilation —a 90% open area! . Mitco performance and service life always measure up to expectations because Mitco's square edge bars are formed into an integral unit and provide a safe, non-slipping, level walking surface. It has no bolts, nuts or rivets to collect dirt and obstruct light. If you will send details of your area to be covered, indicating size, type and location of supports, Hendricks will prepare a Mitco recommendation.

HENDRICK

Manufacturing Company

Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring,
"Shur-Site" Treads and Armorgrids.

46 DUNDAFF STREET, CARBONDALE, PENNA.

Sales Offices In Principal Cities

IMPRISONED!

. . . the Zinc in condenser tubes of CHASE ANTIMONIAL ADMIRALTY*

THERE *was* a time when the zinc in Admiralty Condenser Tubes was hard to hold. Put in a bright, shiny set of new tubes—and the next thing you knew, the zinc was gone. Nothing left but a mass of soft, spongy copper, doomed to early failure.

But now, in Chase *Antimonial* Admiralty, the zinc's locked in : : : to stay for years. That's *proved* beyond doubt by the service records. Millions of pounds in use. Installations dating all the way back to 1935. And scarcely a single failure from dezincification!

Isn't this convincing proof of the effectiveness of antimony as an inhibitor? The next time *you* replace condenser tubes, plan to profit by this longer service life of Chase Antimonial Admiralty—at an initial cost no greater than that of *plain* Admiralty.

*U. S. Pat. No. 2,061,941

Special stocks of ANTIMONIAL-ADMIRALTY Condenser Tubes in Chase Warehouses at LOS ANGELES, NEW ORLEANS SAN FRANCISCO

also carried by— **Vinson Supply Co., TULSA Standard Brass & Mfg. Co. HOUSTON**

Chase BRASS & COPPER CO. INCORPORATED

Waterbury 91, Connecticut
SUBSIDIARY OF KENNECOTT COPPER CORPORATION

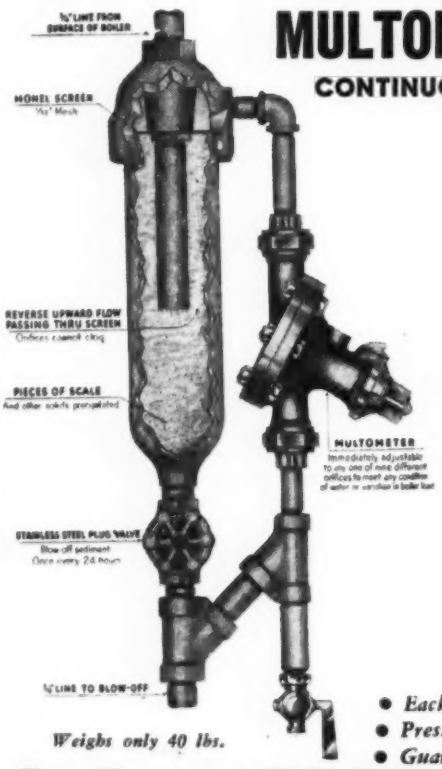
This is the Chase Network—handiest way to buy brass

ALBANY† ATLANTA† BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT HOUSTON† INDIANAPOLIS JACKSONVILLE† KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WASHINGTON† (†Indicates Sales Office Only)

Easy, accurate regulation of boiler blow-off

MULTOMETER SYSTEM

CONTINUOUS BOILER BLOW-OFF



Weighs only 40 lbs.

• NOW, once and for all time, take the guesswork out of boiler blow-off this sure way. Multometer dependability has been proved in service and used with steam boilers of all kinds.

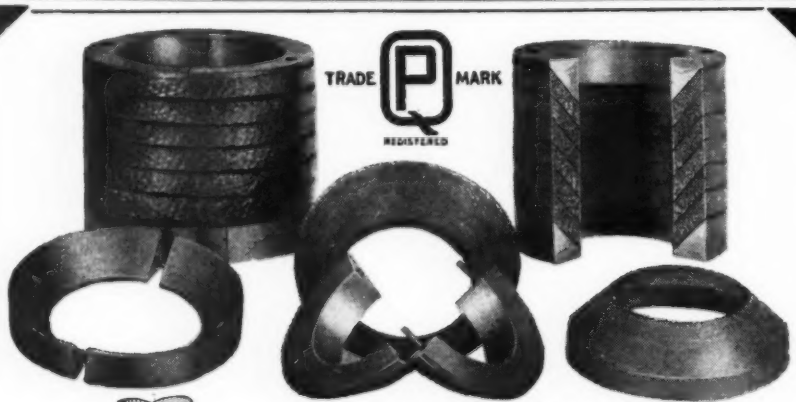
Get increased efficiency of steam generation. Get savings far in excess of installation cost. Get a reduction in your fuel costs. Stop wet steam, foaming, and priming. Write for 6-page bulletin on this modern way to control and remove impurities in boiler water. It shows typical installations of MULTOMETER continuous boiler blow-off. Shows how easily the unit is installed and how effectively it operates.

We supply complete data and working drawings showing the best method of installation on various types of boilers.

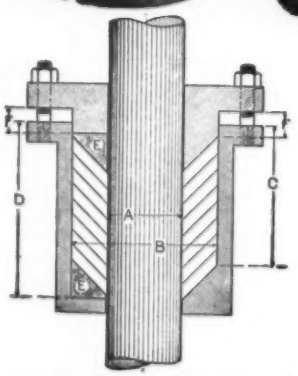
- *Each unit inspected*
- *Pressure tested*
- *Guaranteed Ten Years*

P. E. MADDEN & COMPANY

352 W. WALTON ST. CHICAGO 10, ILL.



TRADE Q MARK REGISTERED



Q Self-Setting PACKING

Q-P Self-Setting Packing has demonstrated its superiority under the most difficult conditions on land and sea and can be depended on to meet post war requirements for high maintenance economy. It is the ideal packing for superheated steam, saturated steam, hot and cold water, ammonia, fuel oil, compressed air, gases and acids and other operating conditions. (For Valves, Turbines, Diesels, Expansion Joints, Hydraulic Equipment, etc.).

(Outline your Packing Problems and Let us show you what "Q-P" Self Setting Packing can do for you.)

THE Q-P MANUFACTURING COMPANY

NEEDHAM HEIGHTS 94, MASS.

BORN

A Year Earlier

Remember the first solo flight, New York to Paris, May 20-21, 1927? Seems sort of ancient now, but it proved the principle of man's mastery over the air. Well,

SAND-BANUM

The Entirely Different Boiler and Engine Treatment"

BORN IN 1926

proved the mastery over boiler scale and corrosion. Its 20 year record in the automatic elimination and prevention of boiler scale and corrosion shows reduced fuel cost and increased power.

Sand-Banum comes in 16 oz. cans, ready to use as is. It's safe to personnel and equipment.

It results in longer equipment life and reduces shut-downs, despite water or operating conditions.

BE A SKEPTIC

TODAY—ask us to prove this to your entire satisfaction.

AMERICAN SAND-BANUM COMPANY, Inc.

9 Rockefeller Plaza, New York 20, N. Y.

Stocks carried by
WESTERN SAND-BANUM COMPANY
Houston, Texas

and at other convenient points including leading supply houses

Export Representatives
PETROLEUM MACHINERY CORP.
30 Rockefeller Plaza New York 20, N. Y.

ANOTHER WILSON FIRST

NOW YOU CAN CLEAN TUBES AS SMALL AS 1/4" I. D.

New Wilson Pistol Grip Provides Complete, Instantaneous One-Hand Control of Speed and Power.

Once again our engineers have developed a simple solution to a very specialized tube cleaning problem. With the Wilson Pistol Grip Tube Cleaner they've proved that even tubes as small as 1/4" I.D. can be cleaned easily, effectively, economically.

The Pistol Grip weighs only 3 pounds — no more than a 12" stilson wrench. It provides the operator with one-hand control for cleaning small, straight tubes of 1/4" to 1" I.D. in sterilizers, hot water heating units, lube oil heaters, oil pre-heaters, heat exchangers and other small bore tube apparatus.

Like the well-known Wilson Trigger Power, Pistol Grip has these exclusive operating features:

1. Higher torque at any speed than any other tube cleaner in its class. This cuts down-time radically and means production dollars saved.
2. Unusually fast action (up to 3500 rpm working speed) permits the use of standard Wilson cleaning accessories.
3. Scavenging agent is carried down the hollow shaft to the cutter-bit . . . even coal oil can be used when it is economically available.
4. Special Rotary Seal at front end prevents leakage of scavenging agent and eliminates stuffing box and packing troubles.
5. Even sagged tubes can be cleaned with Pistol Grip. The hollow shafting has sufficient "give" to follow the contour of the sag without damaging tube walls.
6. Pistol Grip provides the operator with instantaneous one-hand control of speed and power.

Actual photo showing trigger control

These features are your assurance that you will get the kind of tube cleaning you want — the kind you need for full economy and long tube life.

Wilson Pistol Grip tube cleaners are now available from stock. For additional information, please address department M.

TW-718

THOMAS C. WILSON, INC.
21-11 44th Avenue, Long Island City 1, N. Y.

WILSON
TUBE CLEANERS

(IT IS REASONABLE TO ASSUME)

THE COST OF

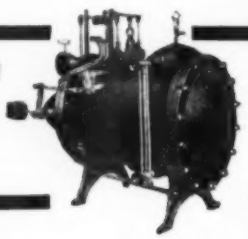
COAL

WILL CONTINUE TO

RISE

The STERLING SYSTEM will save you from 10 to 50% on the cost of fuel. A unique gravity system using 90% less steam than efficient pumps. Handles condensate above 212 degrees—eliminates the use of electricity entirely. Send us your steam problem!

AUTOMATIC!
POSITIVE!
EXCLUSIVE!
UNIQUE!



Sterling Engineering & Mfg. Corp.
(Templeton Mfg. Co.)
110 Business St.,
Hyde Park, 36, Massachusetts

ADACAST

a castable refractory that pours like cement excellent for:

casting
BURNER BLOCKS
and DOOR LININGS
constructing
INTRICATE SHAPES
and BAFFLES

Adacast is structurally strong, with unusual resistance to spalling. It will stand heavy loads without bulging or distortion. Sets with high tensile strength and extreme density. Shows great stability; shrinkage or expansion are practically nil, permitting form to be made actual size. So easy to handle that unskilled plant labor can produce fine finished results.

BOTFIELD REFRACTORIES CO.
784 S. Swanson St., Philadelphia 47, Pa.
In Canada, Canadian Botfield Refractories Co., Ltd., 171 Eastern Avenue, Toronto

Manganese Steel Ash Conveyor Chain Gave Nine-to-One Service Life . . . .

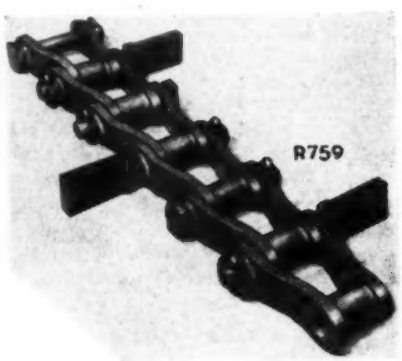
An instance of the long life and economical performance of Amsco Manganese Steel Chain under conditions of wet abrasion is presented in the following letter from the chief engineer of a midwestern power plant:

"The Amsco manganese steel chain (408' of H-drag type) was installed in this plant six years ago and is still in relatively good condition. You will find that we ordered repairs on one or two occasions, but the maintenance has been very low.

"This conveyor handles the ashes from six 800 h.p. boilers, moving them a distance of about 200 feet. The bottom of the conveyor trough in which the chain operates is made of hardened concrete in which is embedded a grating six bars wide, made up of 1" by 1½" by 3' manganese steel bars.

"The first chain used on this ash conveyor was made of mild steel, and had given only nine months' service when it was necessary to replace it. Your chain has been in operation an average of six hours a day, over a period of six years."

A year later, after seven years' service, the Amsco chain, shown in Picture 722, was replaced with another identical lot; the order also including 200 manganese steel trough grate bars.



R-759. Section of an Amsco Manganese Steel clinker drag chain with a total length of 320'.

The two most important requisites in elevator and conveyor chain—durability and freedom from breakdown—find their highest development in Amsco Manganese Steel Chain. Having a test-bar tensile strength of 100,000-130,000 lbs. p.s.i. and a developed-in-service hardness up to 550 Brinell, combined with a tough shock-resisting body metal, manganese steel chain withstands for long periods abuse that quickly destroys ordinary chain.

722. Amsco ash conveyor chain which served seven years in a power plant, as compared with nine months for the chain previously used.

For such applications as ash conveyors, clinker drags and flue cleaners, chain of "the toughest steel known" is most economical in the long run. Send for Bulletin 742C.N, Amsco Manganese Steel Chain.

Joliette Steel Limited, Joliette, Quebec, owned by American Brake Shoe Company, produces and sells Amsco Manganese Steel Castings in Canada.

AMSCO

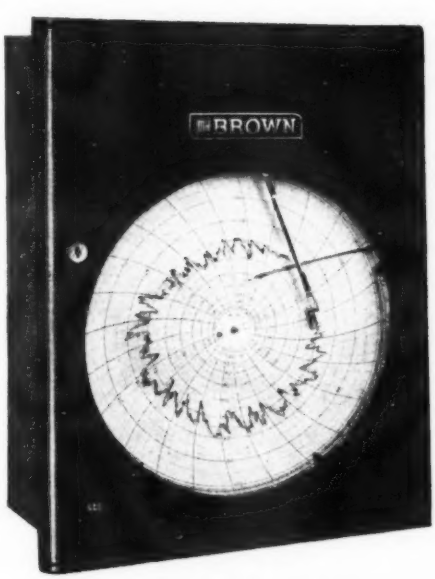
Foundries at
Chicago Heights, Ill.; New Castle, Del.;
Denver, Colo.; Oakland, Calif.;
Los Angeles, Calif.; St. Louis, Mo.
Offices In Principal Cities

AMERICAN MANGANESE STEEL DIVISION
CHICAGO HEIGHTS • ILLINOIS

AMERICAN Brake Shoe COMPANY

How Many Fuel Dollars

Are You WASTING ?



Brown Electric Recording Integrating Flow Meter

FUEL is money. Unless you *know* how much steam is produced and used at all times, you are burning fuel dollars needlessly . . . wastefully.

With Brown Flow Meters, you can correctly determine the cost of making steam for power, processing or heating and properly allocate costs to departments or units. Brown Flow Meter chart records reveal instantly, any deviation above or below the most efficient operating standards of steam generation and distribution.

Thousands of steam engineers are getting this kind of service from Brown Flow Meters. They are easy to install—parts are simple and few. In many plants, the investment for Brown Flow Meters has been repaid many times over. Learn more about them. Write for Catalog No. 2008.

THE BROWN INSTRUMENT COMPANY, a division of Minneapolis-Honeywell Regulator Company, 4490 Wayne Avenue, Philadelphia 44, Pa. Offices in all principal cities.

Toronto, Canada **London, England**
Stockholm, Sweden **Amsterdam, Holland**

BROWN FLOW METERS

. . . MINNEAPOLIS - HONEYWELL CONTROL SYSTEMS . . .

Correct Fuel Distribution in Firebox Cuts Boiler's Coal Need 15%

PATENTED, PRECISION INSTRUMENT INSTANTLY ANALYZES COMBUSTION GASES

Lubrication Engineer's Report

"A check on a boiler in a customer's* plant at Niles, Michigan, demonstrated how the Cities Service Heat Prover shows the fuel saving possible when the boiler is operating efficiently.

"On most under-feed stokers, there is greater depth of burning coal over the retort—leaving the sides and end of the grates with a thin layer of coal. This thin layer of hot coal soon burns through in spots leaving holes in the fire so that the grates are not covered entirely with coal. These bare spots on the grates allow the air to circulate through the firebox without coming in contact with the burning coal, thus increasing the stack temperature with attendant loss of combustion efficiency.

Grates Evenly Covered

"At intervals of thirty minutes, we took a poker, pushed the hot coal from the center, covering the holes and edges of the firebox with coal so that every part of the grates was covered. This registered highest efficiency on the Heat Prover dials.

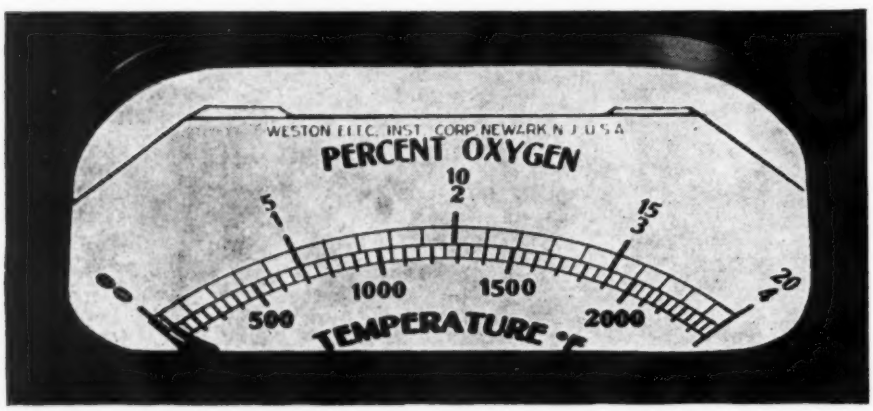
Fuel Cut 3000 lbs. Daily

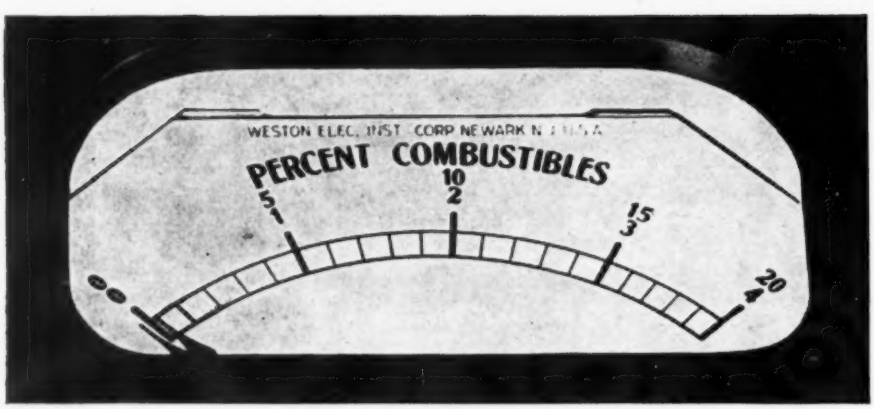
"This boiler was using 18,000 pounds of coal a day and by covering the holes in the fire every thirty minutes, daily consumption was reduced 3,000 pounds a day or a saving of about 15% to 17%."

Heat Prover Service Available

The Heat Prover is a portable combustion gas analyzer patented by Cities Service and operated by trained Cities Service engineers. It is used to check efficiency of every type of fuel combustion equipment. For information call your nearest Cities Service branch office, (Arkansas Fuel Oil Co., in the South); or write to Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

**Name on request.*



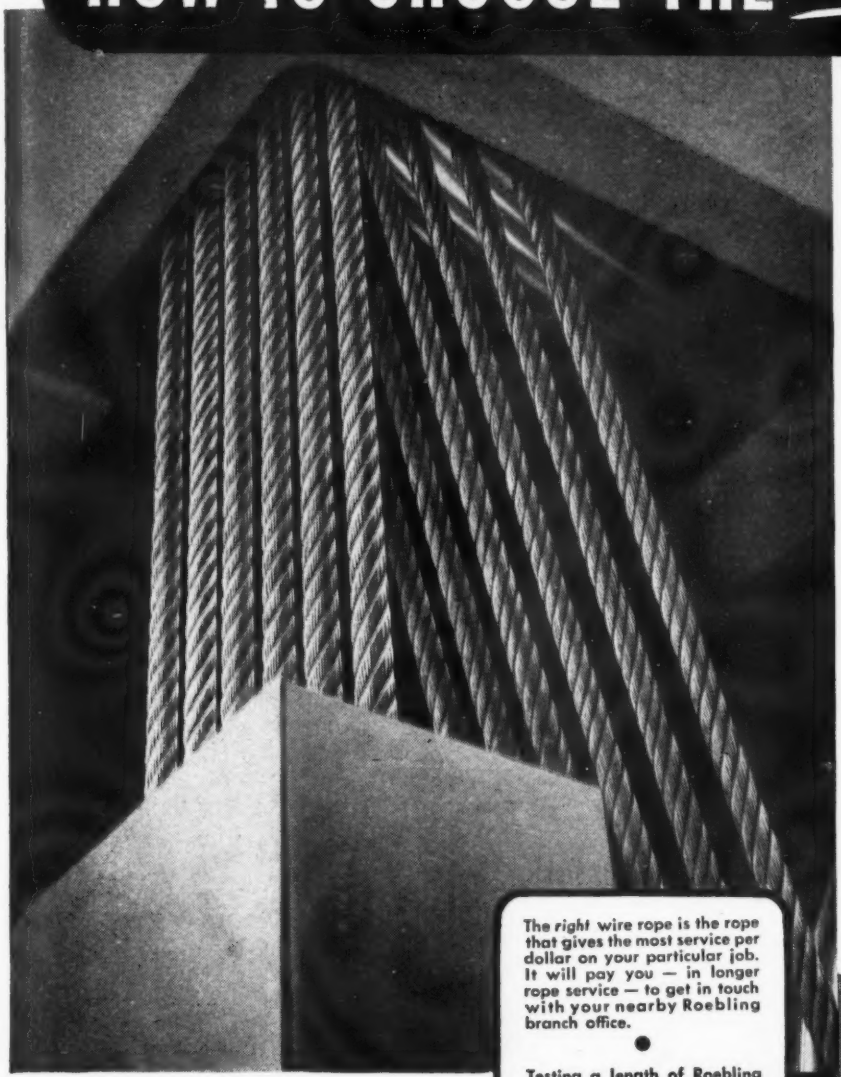


These dials on the compact portable Heat Prover instantly register an analysis of flue gases.

CITIES SERVICE OILS
ONCE-ALWAYS

FOR EVERY LUBRICATION PROBLEM
CALL Cities Service
FIRST!

HOW TO CHOOSE THE *RIGHT* ROPE



. . . and get lowest elevator cost!

YOU DON'T ALWAYS have the time to study the often obscure details affecting wire rope service on your installations. But your Roebling Field Engineer is constantly making such studies.

His daily contacts include tracking down the facts on practically every type of wire rope installation. He has specialized knowledge of wire rope usage . . . and of wire rope, too.

After careful study the Roebling Field Engineer can help you choose the *right* rope . . . the one that will give you top service per dollar. Of course, he will recommend Roebling "Special Traction Steel" Elevator Rope. For here is a complete line where he can find the wire rope that combines the right balance of strength and flexibility, of fatigue and abrasion resistance.

Call or write our nearest branch office. Get in touch with your Roebling Field Engineer.

JOHN A ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

The *right* wire rope is the rope that gives the most service per dollar on your particular job. It will pay you — in longer rope service — to get in touch with your nearby Roebling branch office.

●

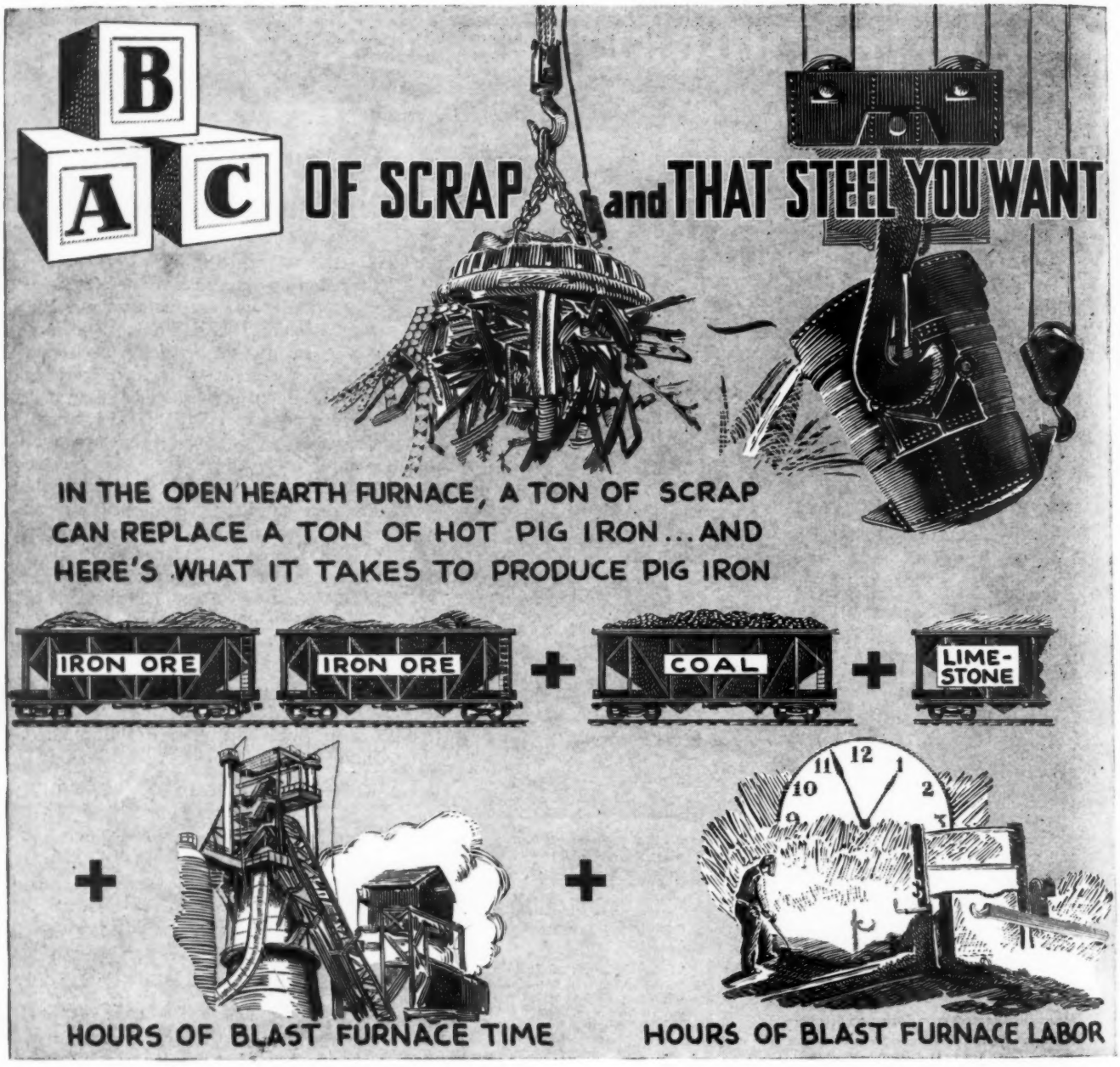
Testing a length of Roebling "Special Traction Steel" Elevator Rope is important — to you. It gives engineering data to your Roebling Field Engineer . . . information that can save your wire rope dollars.

Manufacturers of Wire Rope and Strand • Fittings • Slings • Suspension Bridges and Cables • Aircord, Aircord Terminals and Air Controls • Aerial Wire Rope Systems Electrical Wire and Cable • Ski Lifts • Hard, Annealed or Tempered High and Low Carbon Fine and Specialty Wire, Flat Wire, Cold Rolled Strip and Cold Rolled Spring Steel • Screen, Hardware and Industrial Wire Cloth • Lawn Mowers

PREFORMED • NON-PREFORMED

ROEBLING

PACEMAKER IN WIRE PRODUCTS


B
A C
OF SCRAP and THAT STEEL YOU WANT
IN THE OPEN HEARTH FURNACE, A TON OF SCRAP
CAN REPLACE A TON OF HOT PIG IRON... AND
HERE'S WHAT IT TAKES TO PRODUCE PIG IRON
IRON ORE
IRON ORE
COAL
LIME-
STONE
HOURS OF BLAST FURNACE TIME
HOURS OF BLAST FURNACE LABOR

To you "scrap" may be just worn-out machinery, broken pipe and such junk---worth nothing to your business.

But it IS worth a lot to your business delivered to the steel producer. Scrap may be the means of supplying you with more of the new steel and steel products you want.

As every buyer knows, steel is produced by "blending" hot pig iron and scrap in the open hearth furnace. Each ton of available scrap can replace a ton of pig iron. The greater the shortage of scrap, the heavier the drain on pig iron supply to produce a given tonnage of steel.

But every extra ton of pig iron produced calls for the use of approximately two extra tons of iron ore, one extra ton of coal and one extra half-ton of limestone, processed in a blast furnace, involving many extra hours of time and labor. It is obvious that there is a limit to America's blast furnace capacity. So the quickest, most effective way to produce maximum steel tonnage now is to find and use more scrap.

Help yourself to more steel by starting more scrap into the channels that serve the mills.

QUALITY YOUNGSTOWN SERVICE

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

GENERAL OFFICES - YOUNGSTOWN 1, OHIO

Export Offices - 500 Fifth Avenue, New York City

Manufacturers of

CARBON - ALLOY AND YOLOY STEELS

Pipe and Tubular Products - Sheets - Plates - Conduit - Bars - Electrolytic Tin Plate - Coke Tin Plate - Rods - Wire - Cold Drawn Carbon Steel Rounds - Tie Plates and Spikes.

ONE *recognized standard*

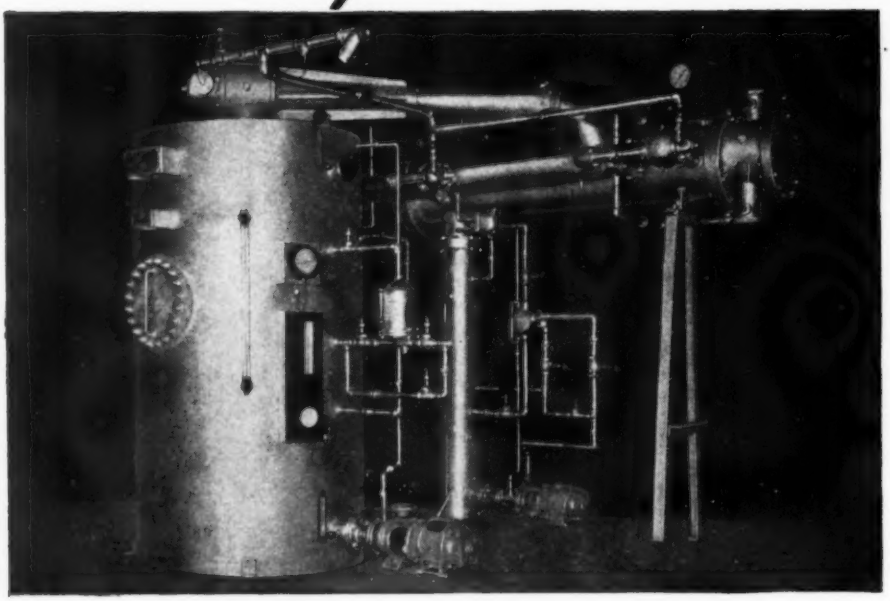
THE COTTRELL PROCESS OF ELECTRICAL PRECIPITATION

FOR GAS CLEANING, smoke abatement and removal of dust, fume, tar and other suspended matter from gas, there has been one universally accepted process for more than thirty years. In answer to your special problem, a Cottrell installation incorporating this rich experience in research, development and worldwide operation means the complete fulfillment of your requirements.

RESEARCH CORPORATION

NEW YORK 17: 405 LEXINGTON AVENUE
CHICAGO 3: 122 SO. MICHIGAN AVENUE

For every process requiring chilled water



...there's a suitable

LUMMUS STEAM JET REFRIGERATION UNIT

Like all Lummus Refrigeration Units, this one is designed for simple operation, long service life, low operating costs, and low maintenance costs.

Cooling water is chilled by the vaporization of part of the water by means of a vacuum above the water's surface created by Lummus jets using either exhaust or live steam. Partial load operation can be controlled automatically or manually.

Lummus steam jet units effect refrigeration economically with minimum quantities of steam and condensing water. Lummus designs and fabricates both surface and barometric condenser type units for all ranges of operating temperatures . . . for petroleum, chemical and other industrial processes requiring chilled water.

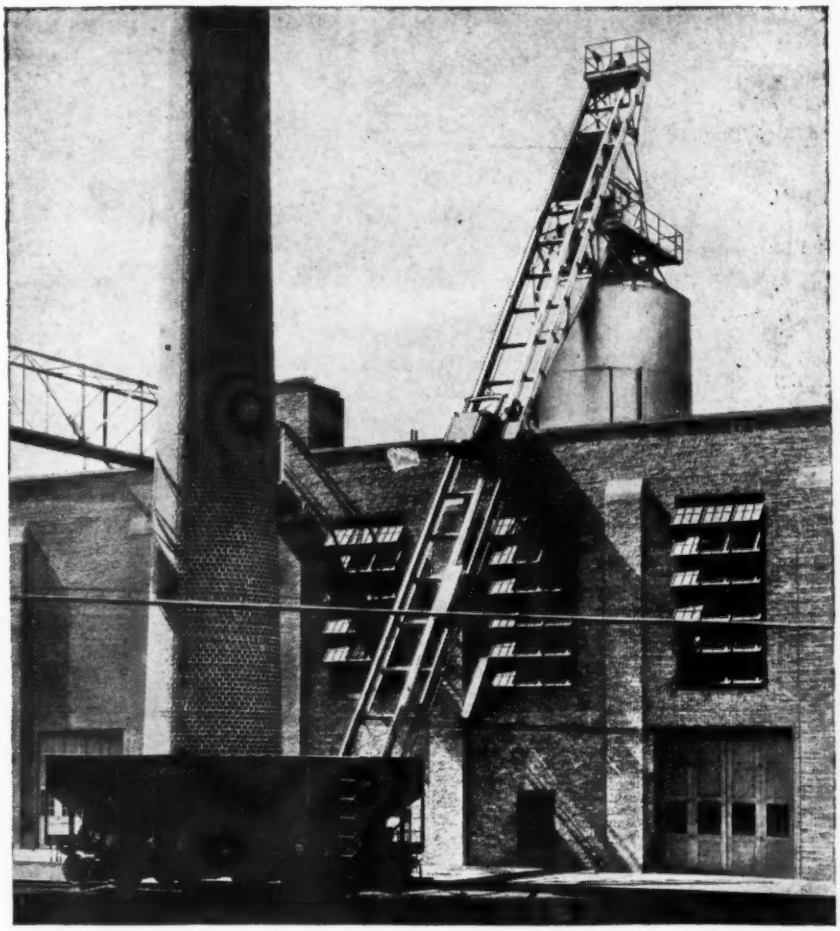
Standardized units are available to meet a wide range of operating requirements and plant conditions. Lummus engineers are always "on call" to help solve specific surface or barometric condenser steam jet refrigeration problems.

For additional information, call or write to your nearest Lummus representative or *The Lummus Company, 420 Lexington Avenue, New York 17, N. Y.* Representatives in principal cities.

LOOK TO LUMMUS FOR:

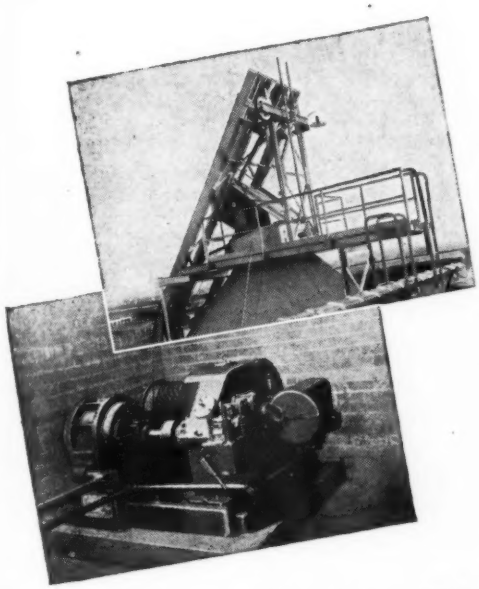
- Heat Exchangers
- Process Condensers
- Reboilers
- Steam Generators
- Steam Jet Refrigeration
- Steam Surface Condensers
- Barometric Condensers
- Steam Jet Air Ejectors
- Evaporators
- Boiler Blowdown Heat Exchangers
- Fuel Oil Heaters
- Lubricating Oil Coolers
- Pipe Line Coolers
- Feed Water Heaters
- Jacket Water Coolers

Lummus STEAM JET REFRIGERATION



SKIP HOISTS

for handling coal and other abrasive materials



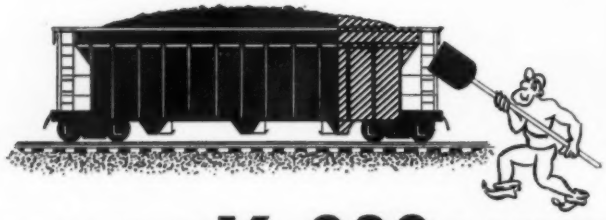
● Reflecting throughout their design and operation, our more than 40 years of cumulative improvements and developments, Bartlett-Snow Skip Hoists will give you a maximum of long, efficient, trouble-free service, with low operating and low maintenance costs. Widely used for handling coal in industrial boiler plants and central stations, also coke, coke breeze, sinter, limestone, ashes and other abrasives when the lift is high. Semi-automatic and full automatic, counterweighted and counterbalanced types. Capacities from 5 to 500 tons per hour. Send for Bulletin No. 83. It gives full details.

THE C. O. BARTLETT & SNOW CO.

6205 Harvard Avenue, Cleveland 5, Ohio

Engineering and Sales Representatives in the Principal Cities

COAL HANDLING FOR CENTRAL STATIONS AND INDUSTRIAL BOILER PLANTS



WHY WASTE 16,000 POUNDS OF COAL EVERY DAY

. . . when you can save it with

HEACON DAMPERS

Damper leakage is a thief that steals more fuel than most people realize . . . For example, a closed damper 6 x 8′ with ¼″ clearance will leak 500,000 cubic feet per hour when the draft across it is 1″ w.g. The production of that much gas requires the efficient burning of 750 pounds of coal per hour . . . or 16,000 pounds every day! And that's assuming that the damper is still in good condition. If it's warped, an even greater fuel waste will result.

Heacon Dampers, however, permit *no* leakage, and *cannot* warp!

Heacon Dampers are tight, because they are made with a flexible curtain that actually seals, by the draft forcing the curtain tightly against the grill and sealing edges of the frame. Thus banking losses and bypass leakages are eliminated.

The flexible sealing medium in the Heacon Damper eliminates leakage due to warpage. And since shafts and bearings are entirely removed from the path of flow, they can be made large enough to avoid sagging or binding.

This is only a preface to the many benefits introduced through the use of Heacon Dampers, designed to eliminate the faults inherent in conventional dampers and to make full use of automatic control.

Write for Heacon Damper Catalog and call nearest Heacon field engineer for a damper engineering recommendation.

THERMIX ENGINEERING COMPANY

Project and Sales Engineers

FIRST NATIONAL BANK BUILDING · GREENWICH, CONN.

HEACON GIVES CONTROLLED FLOW

1. MORE RELIABLE OPERATION
2. INCREASED CAPACITY
3. REDUCED MAINTENANCE
4. GREATER FLEXIBILITY
5. HIGHER EFFICIENCY
6. BETTER REGULATION
7. LOWER BANKING LOSSES
8. QUICKER STARTING
9. SAFER OPERATION
10. CLEARANCE WITHOUT LEAKAGE

HEACON INC DAMPERS

FIELD PROJECT ENGINEERS:

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C. E. Johnson & Associate
Bona Allen Bldg.

BOSTON 10, MASS.
Thermix Engineering Co.
89 Broad St.

BUFFALO 2, N. Y.
Brookman-Hazel Associates
259 Delaware Ave.

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CHATTANOOGA 2, TENN.
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Chattanooga Bank Bldg.

CHICAGO 5, ILL.
Engineering Sales Co.
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Frank Howell Co.
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Lewis, Watts & Freeman, Inc.
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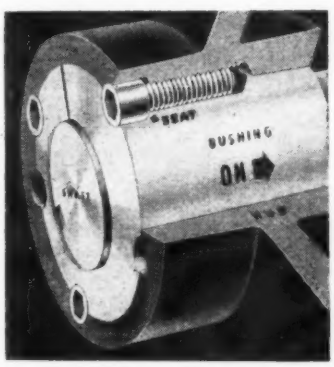
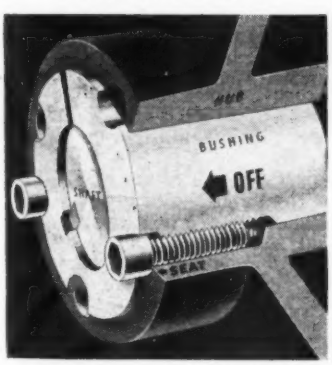
WASHINGTON, D. C.
T. W. McGuire Co.
Bond Bldg.

TAPER-LOCK BRAND

IS THE ONLY TAPER-BUSHED SHEAVE MADE IN ALL THESE SIZES



1. Tighten screw to install.



2. Tighten screw to remove.

THE TAPER-LOCK Sheave is available in Dual Duty sizes from 3 to 18 inch pitch diameter, 1 to 6 grooves inclusive; and in C and D sizes from 9 to 44 pitch diameter, 3 to 10 grooves inclusive. A total of 451 sizes!

For full details call the Dodge Transmissioneer, your local Dodge distributor. Look for his name under "Power Transmission Equipment" in your classified telephone book.

DODGE MANUFACTURING CORPORATION, MISHAWAKA, INDIANA

DODGE
MISHAWAKA

THE SYMBOL THAT CAME TO LIFE

The man who walks into your factory wearing this symbol is the living embodiment of a service which gives you the correct answers to your problems in efficient mechanical transmission of power. He is the Dodge *Transmissioneer*.

Copyright, 1946, Dodge Mfg. Corp.

NAME PLATES

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, ETCHING COMPANY OF AMERICA, 1520 MONTANA STREET, CHICAGO 14, ILLINOIS

GRAPHITE GUS SAYS:

IT'S A JOB FOR GRAPHITE

to prevent failure of ordinary oil and grease

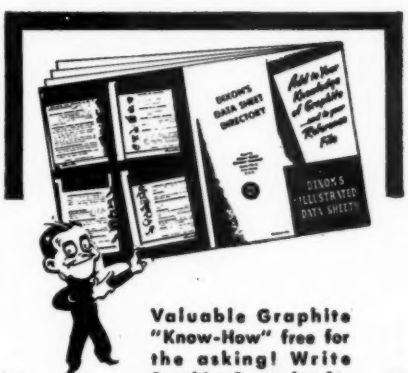
Use DIXON'S Lubricating Graphite on the tough spots. Rub it on dry. Add it to your regular oils and greases.

Dixon's Ticonderoga Lubricating Flake Graphite. Sleeky, large flakes or medium powdered, this graphite gives sustained friction freeing lubrication on packings, large free-fitting bearings, open gears, sprockets, chains and other heavy duty equipment. Add it to oils and greases to fortify them against extremes of temperatures, and pressures. It lengthens lubricant life. Data Sheet #5 tells where and how.

Dixon's No. 635 Lubricating Flake Graphite. This finely powdered graphite is particularly suitable for close-fitting bearing surfaces and mechanisms operating under high temperatures, pressures and speeds. It is extremely unctuous and is used dry. Added to oils and greases it lengthens their life and makes better friction fighters. Data Sheet #6 illustrates uses.

Dixon's Microfyne Lubricating Flake Graphite. Being microscopic in particle size, this lubricating flake graphite is especially processed to meet the largest variety of applications. As a co-lubricant in plain oils and greases it enables them to stand up under conditions of extreme heat, cold, speeds and pressures. Used dry it quickly establishes a friction-free surface. Data Sheet #7 shows other uses.

Dixon's Graph-Air Gun, Type 4. Handily blows its contents of dry Microfyne Graphite into locks and all close-fitting mechanisms. Provides long lasting lubrication that's exceptionally resistant to conditions that destroy ordinary lubricants. This powdered graphite will not gum or dry out. In plant, office, home, Dixon's Graph-Air Gun is the most useful lubricator ever. Data Sheet # 8 lists many of its 1001 uses. Get your gun at Supply or hardware store—30¢.



Valuable Graphite "Know-How" free for the asking! Write Graphite Gus today for Data Sheets No. 5, 6, 7 or 8 and Dixon's illustrated Data Sheet Directory.

You will likely be amazed to also learn what the Complete Line of Dixon's Graphite Products has done for others, and can do for you.

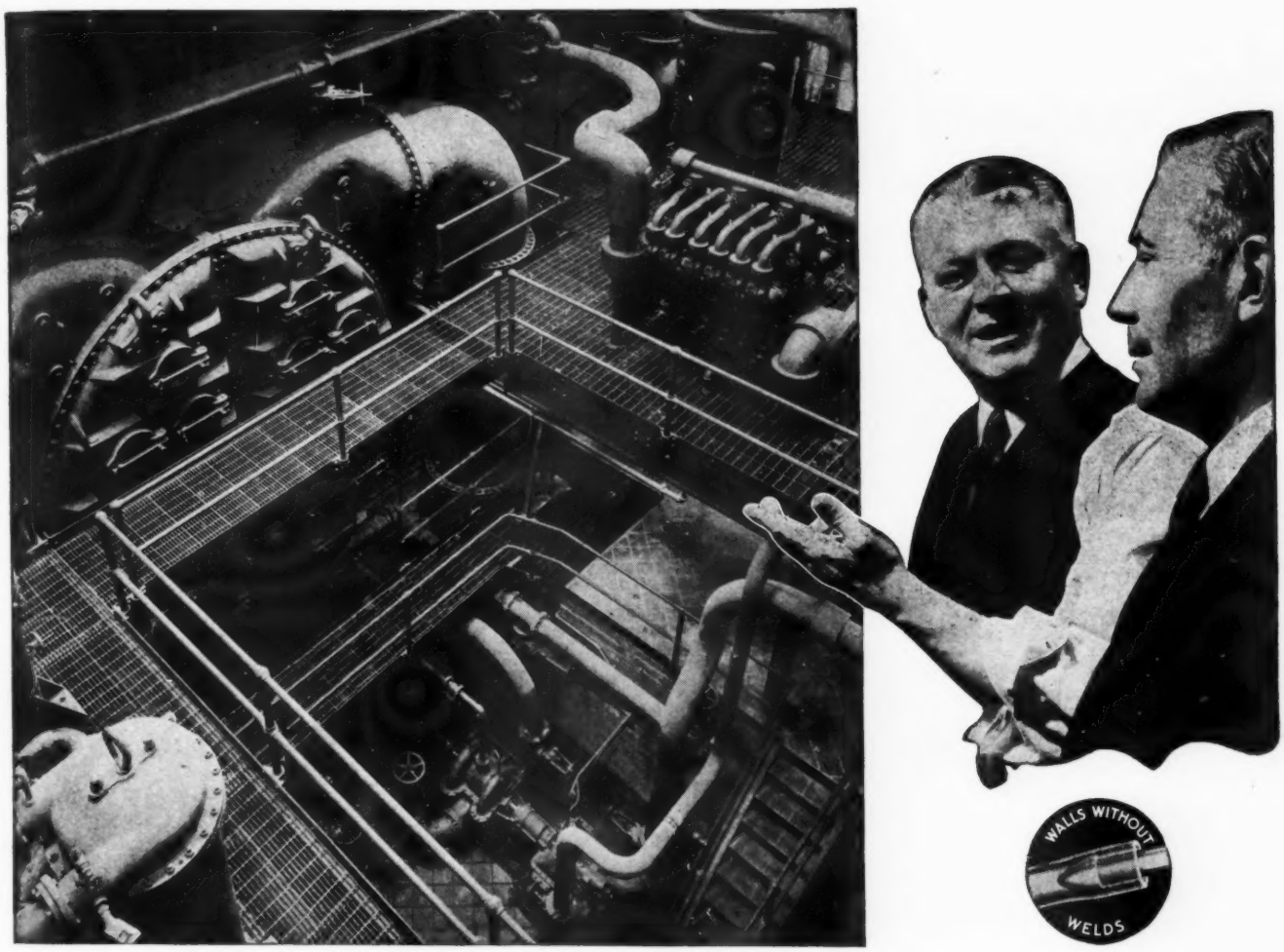
YOUR SUPPLY HOUSE SELLS THE COMPLETE LINE OF DIXON'S GRAPHITE PRODUCTS

JOSEPH DIXON CRUCIBLE COMPANY

DIV. 94C10 — JERSEY CITY 3, NEW JERSEY

BECAUSE— Seamless stands for Safety

FAR-SIGHTED ENGINEERS PREFER U·S·S NATIONAL



WHEN you're dealing with high temperatures and high pressures, why take chances? Standardize on U·S·S NATIONAL Seamless—the *safest* pipe ever developed for critical power plant service.

To seasoned power plant designers and operating engineers, "Walls Without Welds" are three words that have come to stand for the finest in industrial piping. They mean dependable long-life pipe that has for many years demonstrated its outstanding ability to resist the severest conditions of temperature and pressure. Pipe that's pierced from solid billets of high quality steel. Pipe with no line of potential weakness to limit safe operating pressures. Pipe that can be trusted without reservations to do the job—NATIONAL Seamless.

NATIONAL Seamless has inherent safety to recommend it. Every length is a homogeneous, soundly formed cylinder with full wall strength, accurate in dimensions, and uniform in physical properties. Every length is carefully tested and inspected to required specifications.

When ordering seamless pipe, be sure to say NATIONAL Seamless and secure America's Preferred Seamless Pipe for power plant service.

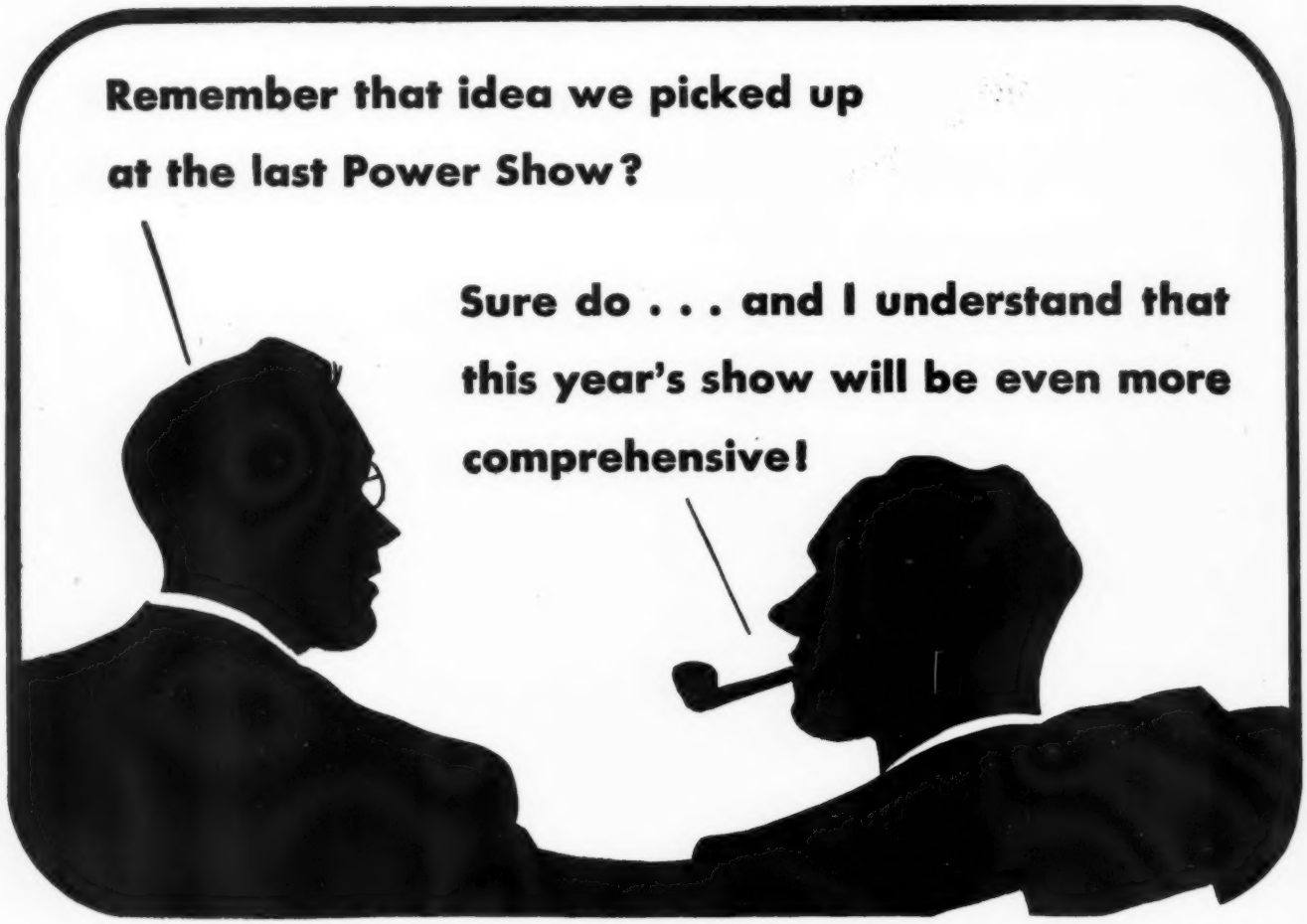
NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Export Company, New York

UNITED STATES STEEL


Remember that idea we picked up at the last Power Show?
Sure do . . . and I understand that this year's show will be even more comprehensive!

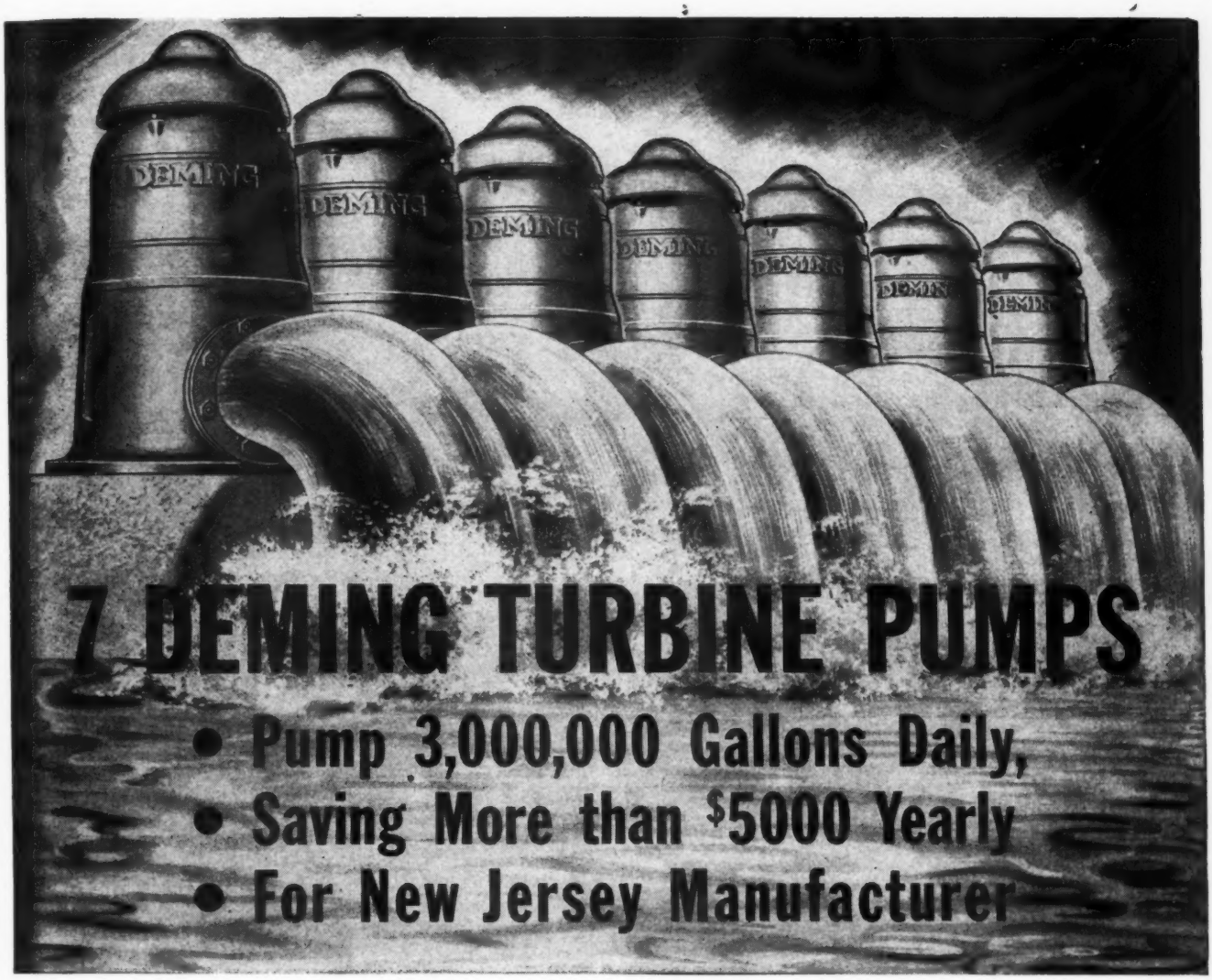
IDEAS? Yes, there will be plenty of them in the 350 exhibits at the 1946 Power Show. Production ideas . . . maintenance ideas . . . *money-saving* ideas. Come and see what the nation's leading suppliers of power equipment are doing and thinking about. Talk to specialists at the informative exhibits.

The Power Show is for *power men.* General public not admitted. Admission by registration. Reserve the date. Be there with your associates.

1413

17th NATIONAL POWER SHOW

GRAND CENTRAL PALACE, NEW YORK • DEC. 2-7, 1946



7 DEMING TURBINE PUMPS

- **Pump 3,000,000 Gallons Daily,**
- **Saving More than $5000 Yearly**
- **For New Jersey Manufacturer**

The first of seven Deming Deep Well Turbine Pumps was installed ten years ago for a manufacturer in New Jersey. That first pump was "on probation" as the manufacturer was frankly skeptical that a motor driven pump could reduce operating costs and, at the same time, increase the yield from each well in a comparison test with the steam driven air lift system employed for factory water supply.

RESULTS OF THE TEST

1. *Efficiency factor:*
Air lift system pumped 5.2 G.P.M. per H.P.
Deming Turbine pumped 20.8 G.P.M. per H.P.

2. *Capacity factor:*
Air lift system yielded 96½ G.P.M.
Deming Turbine yielded 208½ G.P.M.

3. *Cost factor:*
Savings of more than $5000 annually with Deming Turbine Pumps.

Seven Deming Deep Well Turbine Pumps were installed to replace the former steam driven air lift system. Those seven pumps increased the total yield from 2¼ million gallons daily to more than 3 million gallons daily AT LESS COST!

THE DEMING COMPANY • SALEM, OHIO

You can pump MORE for LESS

with **DEMING** *deep well turbine pumps*

Typical comments by Diesel Operators

who use Gulf Parvis Oil:

"Contributes to higher efficiency"

"Insures more operating hours between overhauls"

"Keeps our maintenance costs down"

Gulf Parvis Oil proved so satisfactory in this big 3500 h.p. Diesel that it was selected to lubricate another similar unit recently installed in the same plant.

FOR over 15 years Gulf Parvis Oil has been a leader in the lubrication of industrial and marine Diesels. Ask users why they prefer Gulf Parvis Oil, and their answers add up to something like this: "We get higher efficiency and lower maintenance costs."

Now modern petroleum technology has made possible a further improvement in this quality oil! The improved Gulf Parvis Oil has greater resistance to oxidation, longer life, and is non-foaming!

In your Diesels, this top quality oil means less wear, better performance, and a new low ceiling on maintenance costs. Call in a Gulf Lubrication Service Engineer today and ask him to recommend the proper grade to fit your particular requirements. Write, wire, or phone your nearest Gulf office.

GULF INDUSTRIAL LUBRICATION

Gulf Oil Corporation · Gulf Refining Company

Division Sales Offices:
Boston · New York · Philadelphia · Pittsburgh · Atlanta
New Orleans · Houston · Louisville · Toledo

This chart will tell you how much money you can save by installing Cochrane Continuous Blow-off and about how much it will cost you

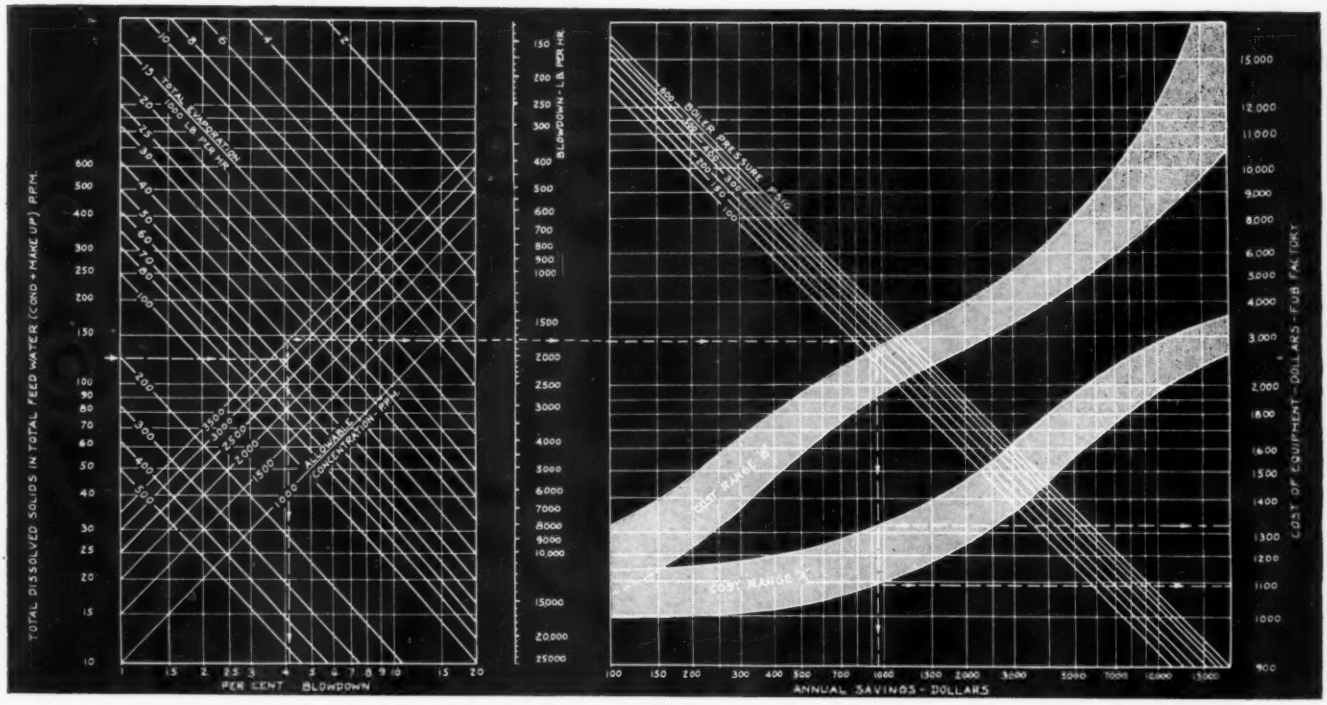

TOTAL DISSOLVED SOLIDS IN TOTAL FEED WATER (COND + MAKE UP) PPM.
TOTAL EVAPORATION 1000 LB PER HR
ALLOWABLE CONCENTRATION PPM
PER CENT BLOWDOWN
BLOWDOWN - LB PER HR.
BOILER PRESSURE PSIG
COST RANGE "B"
COST RANGE "A"
ANNUAL SAVINGS - DOLLARS
COST OF EQUIPMENT - DOLLARS - FOB FACTORY

CHART FOR ESTIMATING SAVINGS BY, AND COST OF COCHRANE CONTINUOUS BLOW-OFF EQUIPMENT

DIRECTIONS: The left hand abscissa is the total value of Total Dissolved Solids (TDS) in the total feedwater to the boiler including make-up and all returns. Its actual value is found by multiplying the TDS in the raw make-up by the per cent of make-up.

Example: Assume—

TDS = 125 ppm.
Allowable boiler concentration = 3000 ppm.
Total evaporation = 40,000 lb. per hr.
Boiler Pressure = 200 psig.

Enter chart at the left at 125 ppm. and draw a horizontal line to the 3000 ppm. Allowable Concentration line. Through this point draw a vertical line to the bottom of the chart and read the per cent of blow-down (4.2 approximately). Now extend the vertical line (if necessary) until it intersects the proper Total Evaporation line (40,000 lbs. per hr.) and draw a horizontal line to the right from this point of intersection to the proper Boiler Pressure (200 psig.), reading the total blow-down (1754 lbs. per hr.) where the line intersects the blow-down column. From the intersection of this line with the proper Boiler Pressure line, drop a vertical line to the bottom of the chart and read the approximate Annual Savings ($950) for operation 24 hrs. per day, 300 days per year, with 75 per cent boiler efficiency and 14,000 Btu per lb. coal at $5.00 per ton on the grates. (For values other than these multiply the annual savings by the appropriate factor, as, for instance, for 12 hr. operation multiply the anual savings by one-half.)

Where this last line intersects the limits of Cost Range "A," draw two horizontal lines to the right-hand edge of the chart and read the approximate Cost of Equipment ($1090 to $1320) for a Class I system.

For total evaporations in excess of those covered by the chart, divide the total evaporation by ten and proceed as before, multiplying the determined blow-down and annual savings values by 10 for final result. When this procedure is followed, Cost Range "B" is to be used directly without multiplying any factor.

COCHRANE CORPORATION

3106 N. 17th Street, Philadelphia 32, Pa.

Further details on Continuous Blow-off and its surprising economies are contained in an article, "Continuous Blow-off for Boiler Plants," by Herman Ebert and Joseph Thompson, a reprint of which will be sent on request.

There's a Brighter Spot in Your Coal Picture

with AMERICAN RING CRUSHERS

More Efficient Coal Preparation

Because of diminished production, coal piles may not be normal for some time to come. To help offset this condition proper reduction of coal to uniform sizes is important. Control of fines and no oversize makes each ton go farther. The uniform reduction of American Rolling Ring Crushers reduce the waste of unwanted fines and eliminate oversize.

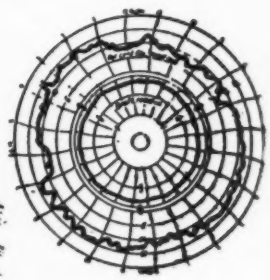
Greater Combustion Efficiency . . .

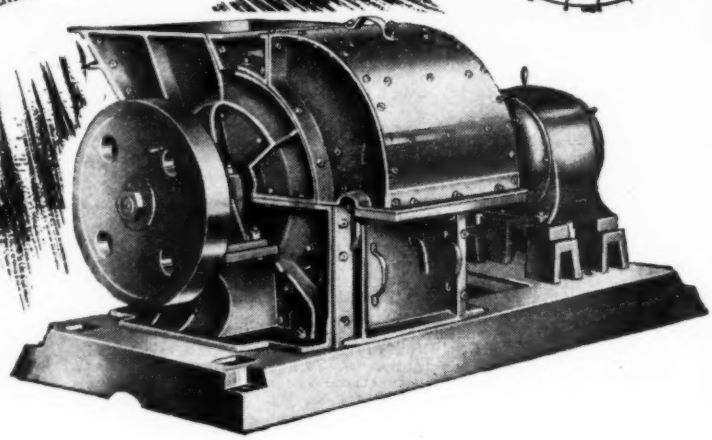
For the greatest possible BTU yield per pound of coal from available grades in your field . . . uniform reduction is essential. *All* grades of coal are reduced to a uniform product from ROM or lump by American Rolling Ring Crushers. The uniformly crushed product results in reduced CO_2 loss from excess air and reduced ash pit loss.

Low Cost Operation . . .

With the uptrend in fuel prices and operating costs, the extremely low operating cost of Americans effect savings that help offset other cost increases. The total operating cost of Americans is less than 1c per ton.

Graphically illustrating increased ash pit loss and low combustion efficiency resulting from improperly prepared coal, the CO_2 chart below emphasizes the need for proper coal sizing such as Americans give.





COAL IS SPLIT - NOT CRUSHED

Only Americans have the patented Manganese Shredder Rings that split coal instead of crushing it. Each ring has 20 cutting edges and is free to swing by centrifugal force. It deflects upon contact with tramp metal and eliminates the need for shear pins and other conventional safety devices.

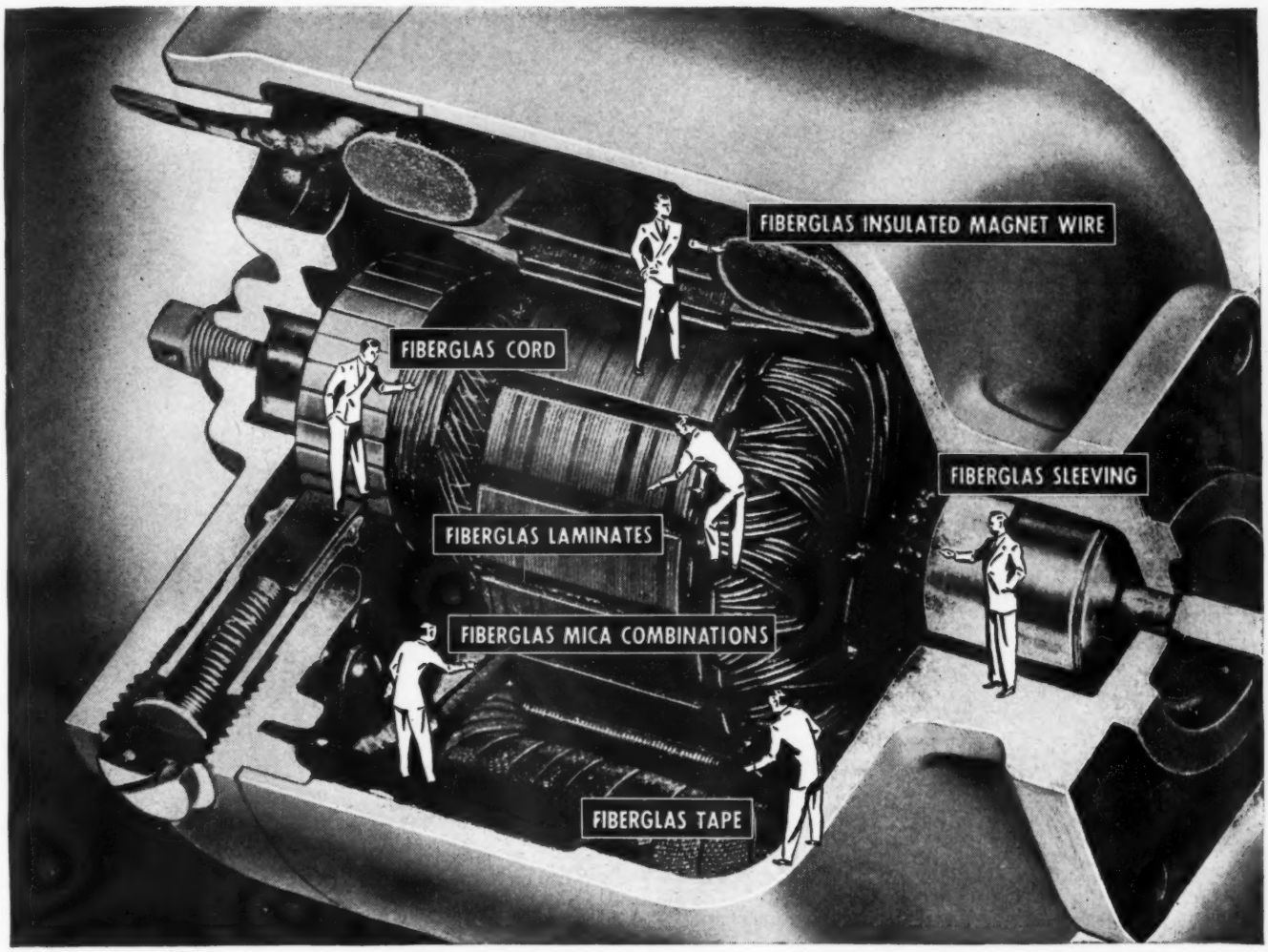
The American Rolling Ring Type "S" Crusher, shown above, has set a high standard for efficient fuel sizing and crushing. Dependable, economical service is a certainty with an American. Low power demand, minimum maintenance and a high rate of operating efficiency are factors that assure lowest operating cost. Custom-built, there's an American to fit your specific job requirements.

Write for bulletin "Crushing Coal at Less Than One Cent a Ton."

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 Macklind Avenue
St. Louis 10, Mo.



Why "High-Safety-Factor" Insulation means greater motor STAMINA

In step with modern design and manufacturing practice is the increasing use of Fiberglas High-Safety-Factor Insulation Material. There is a Fiberglas Electrical Insulation Material for virtually every insulation need.

Fiberglas provides a thin, strong, flexible, *inorganic* base for insulating impregnants. This better insulation material has a unique combination of desirable mechanical and electrical characteristics found in no other single material. It helps provide greater protection against the *enemies of insulation*—excessive moisture, oil, heat, overload, most corrosive acids and vapors and human carelessness—the causes of most motor burnouts and failures.

Because Fiberglas Insulation helps give motors greater stamina, engineers and maintenance men, in every industry, are specifying and standardizing on Fiberglas Electrical Insulation—realizing that even one motor failure can cause time and dollar losses far greater than the slightly higher initial cost of equipment insulated with Fiberglas.

Fiberglas is the trade name for these electrical insulation materials and many other products made from fine, strong, pliable, moisture and heat-resistant, ageless glass fibers.*

Write for catalog EL 44-7, containing complete information about the unique combination of characteristics which make Fiberglas a better electrical insulation material. Owens-Corning Fiberglas Corporation, Department 2000, Toledo 1, Ohio. Branches in principal cities.

In Canada: Fiberglas Canada Ltd., Toronto, Ontario

ASK FOR FIBERGLAS—IN YOUR NEXT MOTOR—AND ON YOUR NEXT REWIND

OWENS-CORNING
FIBERGLAS

***OTHER FIBERGLAS PRODUCTS: Thermal Insulations • "Dust-Stop" Air-Filters • Fiberglas Yarns and Cloths • Fiberglas Mats**

"No trouble with Rust ...since switching to Tycol RIO Turbine Oils"

"No detectable sludge...
No emulsification...
Viscosity unaltered...
Negligible change in acidity"

That's how engineers describe the improved results achieved with Tycol RIO Turbine Oils. These oils assure maximum economy . . . unqualified protection . . . top lubrication efficiency.

Contact your nearest Tide Water Associated Office today for complete data on the many advantages of Tycol RIO Turbine Oils.

LUBRICATION—"ENGINEERED TO FIT THE JOB"

TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C.
Pittsburgh • Philadelphia

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE • NEW YORK 4, N. Y.

The Man in the Field KNOWS when Pre-Fabricated Piping is Right

Men in the field who erect piping know when shop fabrication is well done . . . they know if the sub-assemblies fit correctly, line up easily and have all field welds or flanged joints in accessible positions. When this is the case, the erecting job is easier . . . saves both time and money.

Midwest has a Construction Department which has erected piping of all kinds for 46 years. The critical attitude of this department is the best stimulant to our four pipe-fabricating plants. The Construction Department also frequently contributes useful and practical suggestions for improving pipe fabrication.

This situation has a powerful effect in keeping the whole organization alert . . . and in encouraging continuous improvement. It is one of many reasons why you get the best when you buy Midwest Pre-Fabricated Piping . . . either as materials furnished or piping completely installed.

MIDWEST

CONTRACTING DEPARTMENT *Checks*

MIDWEST PIPING QUALITY

MIDWEST PIPING SERVICE IS NATION-WIDE

MIDWEST

PIPING & SUPPLY CO., INC.

MAIN OFFICE: 1450 SOUTH SECOND ST., ST. LOUIS 4, MO.

Plants: St. Louis, Passaic, Los Angeles and South Boston • Sales Offices: New York 7—30 Church St. • Chicago 3—645 Marquette Bldg. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—533 Mayo Bldg. • Atlanta 3—Red Rock Bldg. • South Boston 27—426 First St.

2266

Spiral-wound gaskets represent the logical approach to difficult sealing problems—BUT there's much more to it than this. Only in Flexitallic — the *original* spiral-wound gaskets — do you benefit from exclusive precision methods that permit winding to exacting tolerances which cannot be equalled elsewhere in the industry. Only in Flexitallic Gaskets do you get design that is specifically balanced with specific fitting and service requirements.

And only through individually engineered construction and exclusive patented features can you be assured of the dependable, trouble-free service for which Flexitallic Spiral-Wound Gaskets have been famous for over a third of a century. Write for catalog.

"Flexitallic"
REG. U. S. PAT. OFFICE

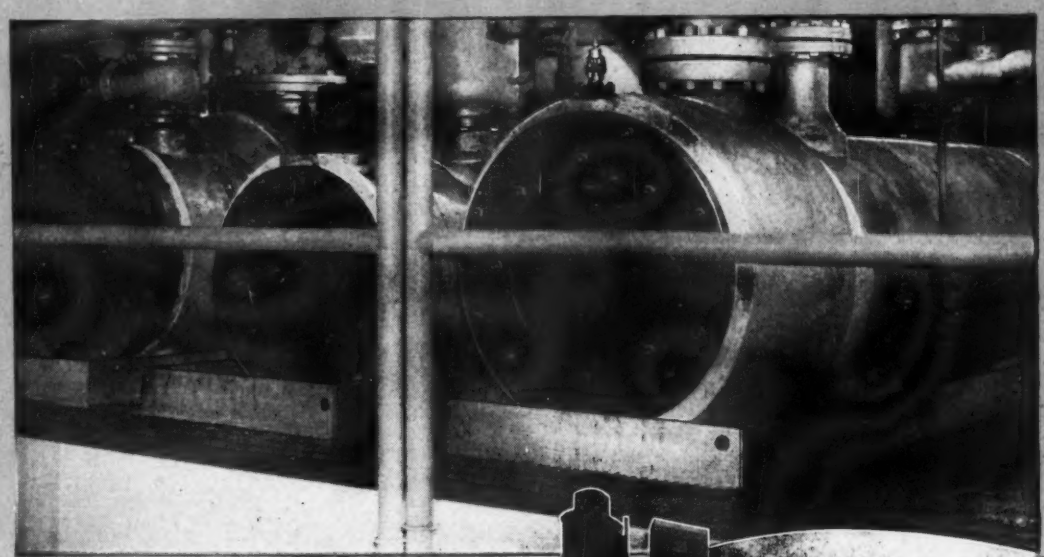
GASKET COMPANY
8th and BAILEY STREETS, CAMDEN, N. J.

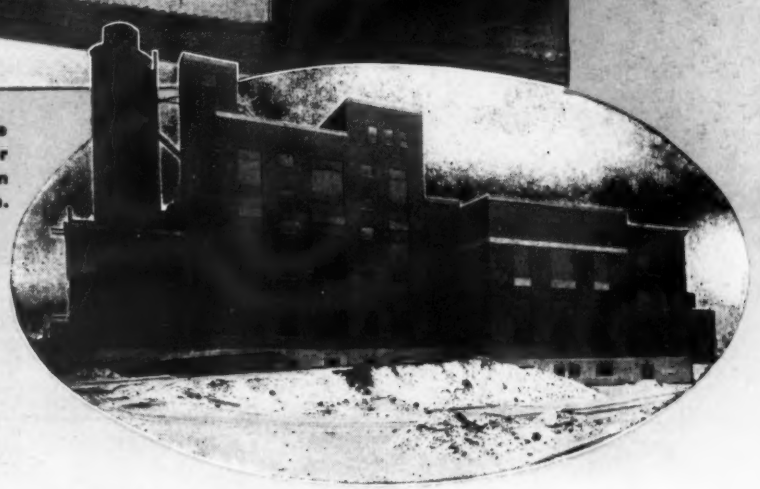
THE ANSWER TO 1001 DIFFICULT GASKET PROBLEMS

SW STRUTHERS WELLS

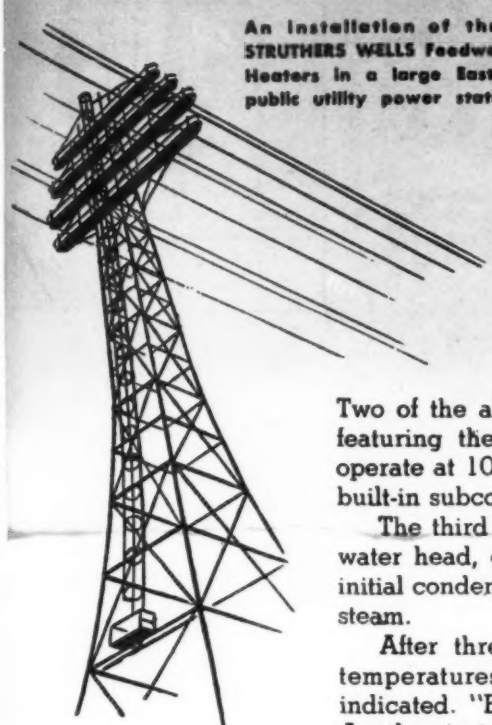
feedwater HEATERS

FOR HIGH PRESSURE SERVICE





An installation of three STRUTHERS WELLS Feedwater Heaters in a large Eastern public utility power station.



Two of the above FEEDWATER HEATERS are high pressure units, featuring the STRUTHERS WELLS' "Boltless Head" closure, and operate at 1000 lbs. pressure. One of these heaters also includes a built-in subcooling section.

The third unit is a low pressure heater with conventional bolted water head, employing a steam distribution belt to afford sufficient initial condensing surface to most effectively handle the low pressure steam.

After three years of constant service without cleaning, outlet temperatures had only dropped a few degrees, cleaning was indicated. "Boltless Head" closures have been proven trouble-free. Another installation is now being made for the same company at a new plant.

Write for descriptive, technical Bulletin No. B-17.

STRUTHERS WELLS CORPORATION

Process Equipment Division

WARREN, PENNA.

PLANTS AT WARREN, PENNA. AND TITUSVILLE, PENNA.

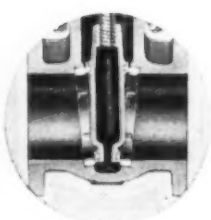
WALWORTH PRESENTS

A New Line of

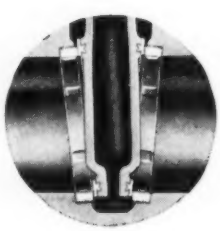
IRON BODY GATE VALVES

with screwed or flanged ends

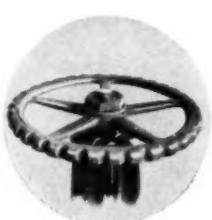
... 8 Outstanding Features



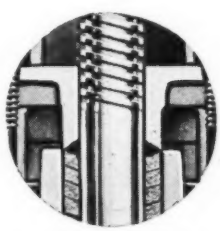
Straight-Flow Port Design reduces fluid turbulence to a practical minimum.



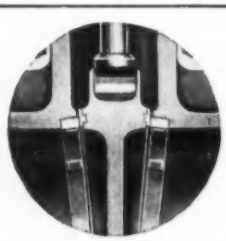
Seat Rings of end-seated type are screwed into the body.



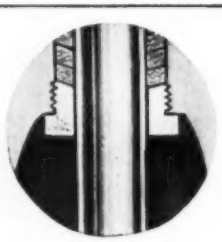
Sure-Grip Malleable handwheel for non-skid gripping even with heavy gloves.



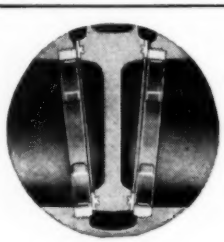
Brass Liner on Glands assures greater resistance to corrosion and scoring.



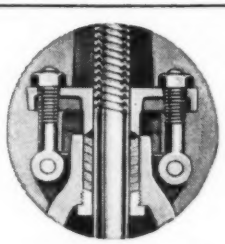
T-head disc-to-stem connection on OS&Y types provides stronger connection, prevents loosening of disc by corrosion.



Bronze back-seat bushings in bonnets of OS&Y valves. (As soon as W.P.B. Limitation order permits.)



Solid Web Type disc in OS&Y) valves for greater strength and longer service.



Hinged Gland Eye-Bolts on OS&Y valves permit faster, easier repacking under full pressure.

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valves and fittings

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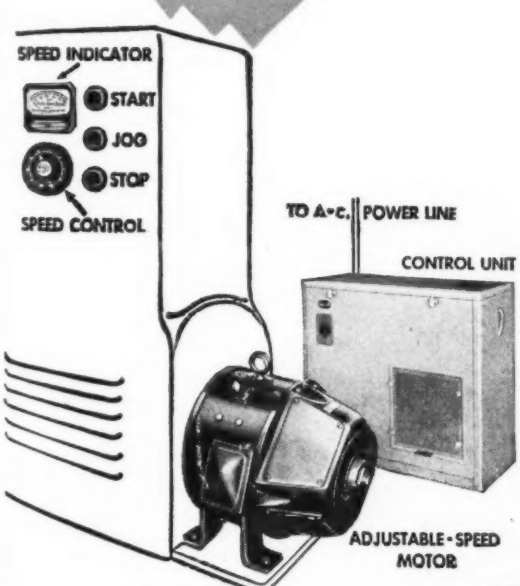
STEPLESS Speed Changes

. . . from A-c. circuits!

RELIANCE V★S DRIVE



Conveniently-packaged, space-saving V★S Drives available in Rotating or Electronic Systems or a combination of both.

V★S, the *All-electric, Adjustable-speed Drive operating from A-c. Circuits,* brings to any production or processing operation an unlimited selection of *stepless* speed changes. Acceleration and deceleration are unbelievably smooth. And every V★S function can be performed automatically or manually, with all-electric control from nearby or remote stations!

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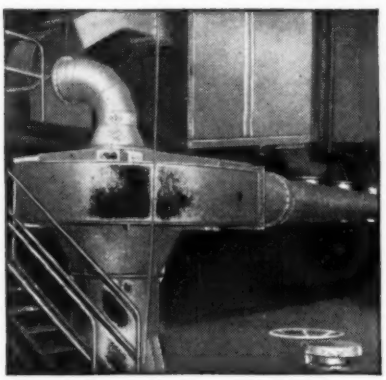
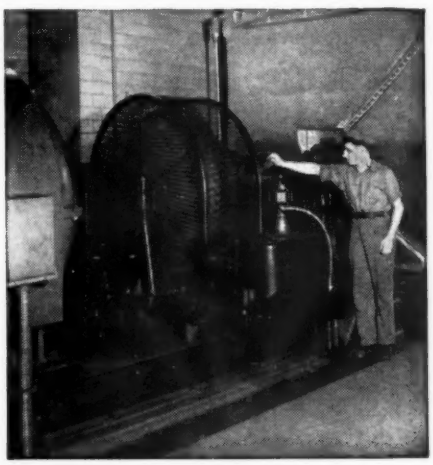
1 Mechanical Draft Fans have been designed and built by American Blower since 1881. Constant research in our laboratories insures increased overall power plant efficiency and long life of equipment.



2 Precipitators for fly ash and cinders were developed by American Blower from long association with power plant equipment and its operation. The design of our precipitators is simple and effective—no moving parts, occupy the minimum of space.



3 Gyrol Fluid Drive was first introduced to industry by American Blower in a power plant installation over 13 years ago. Here is the answer to stepless variable speed control for both mechanical draft and boiler feed pump drives — improved overall power plant efficiency, too.

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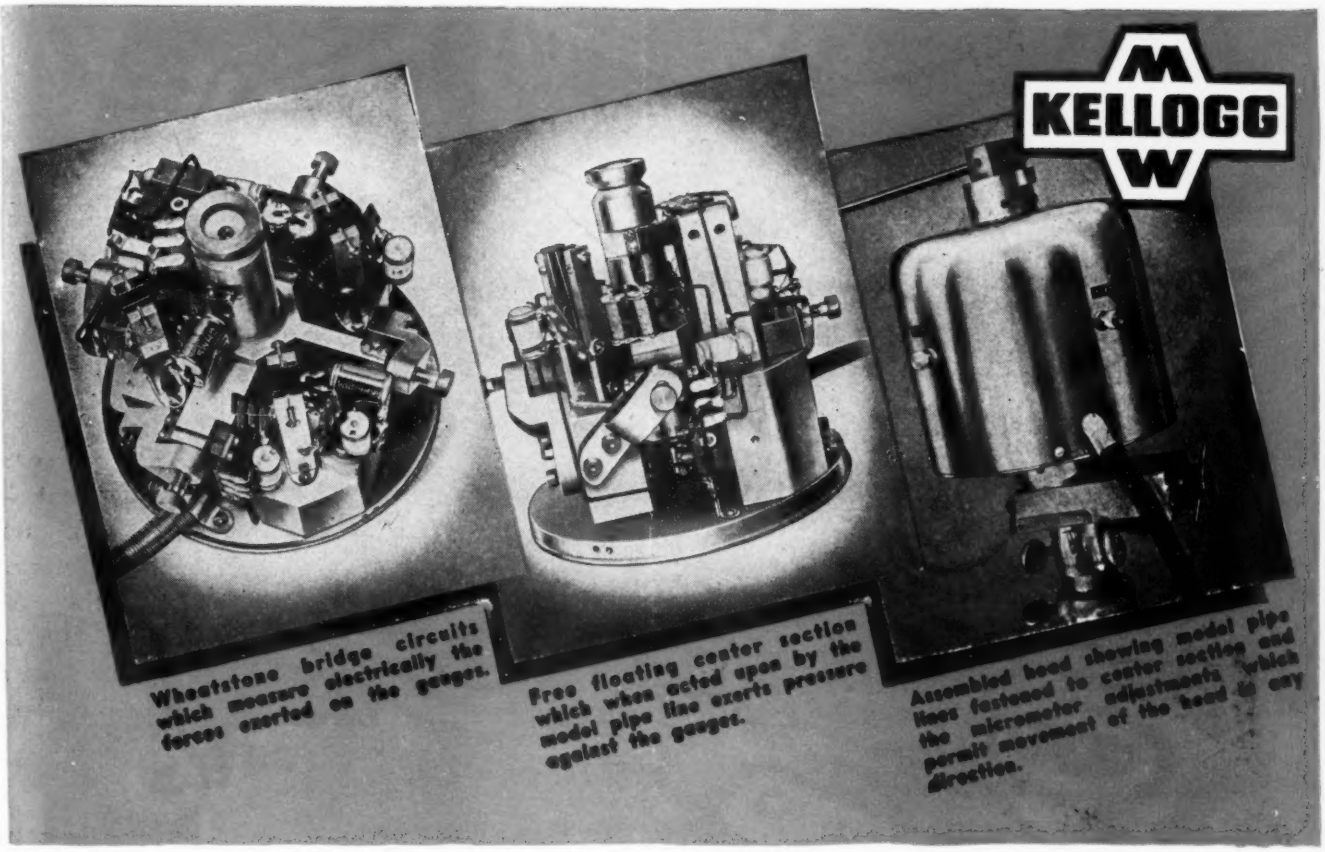
M
KELLOGG
W
Wheatstone bridge circuits which measure electrically the forces exerted on the gauges.
Free floating center section which when acted upon by the model pipe line exerts pressure against the gauges.
Assembled head showing model pipe lines fastened to center section and the micrometer adjustments which permit movement of the head in any direction.

These Heads Measure Load Deflections to ONE-MILLIONTH of an INCH

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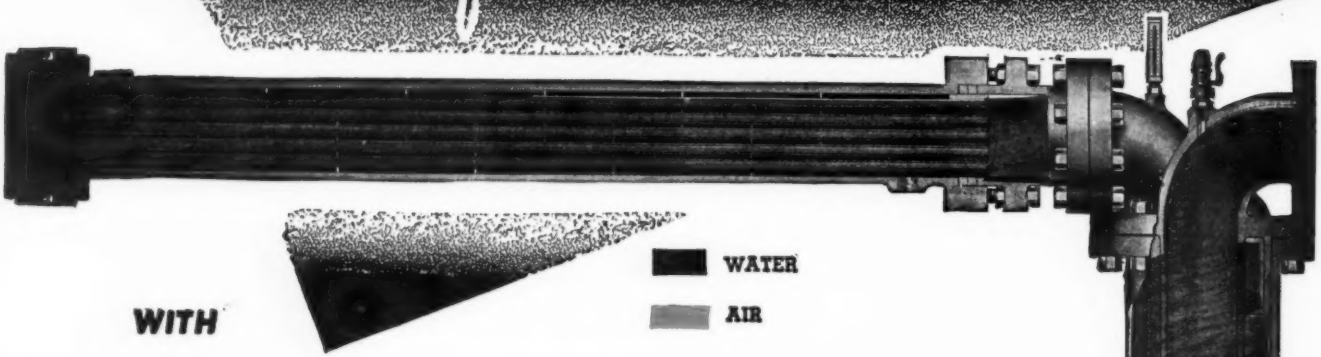

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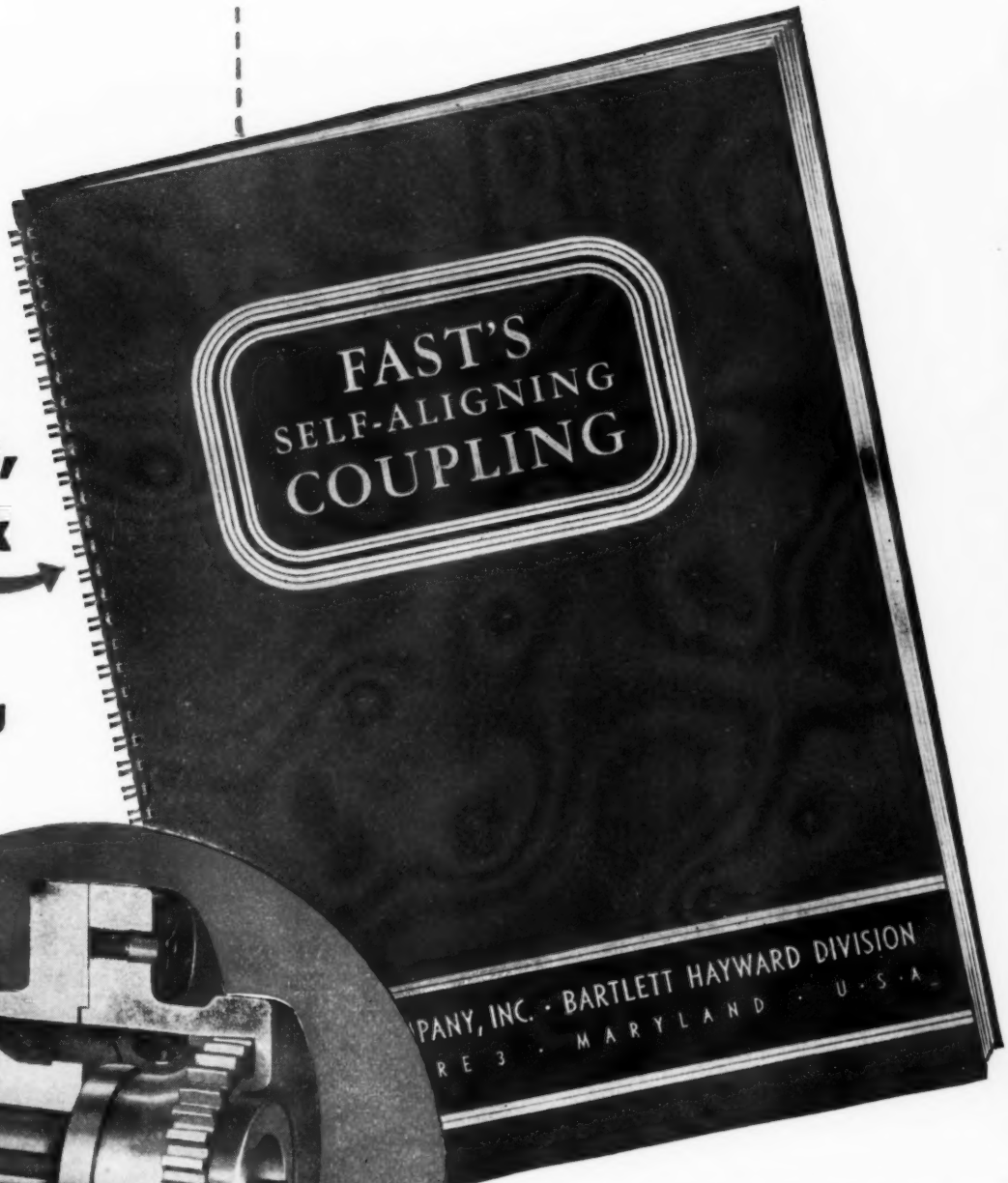
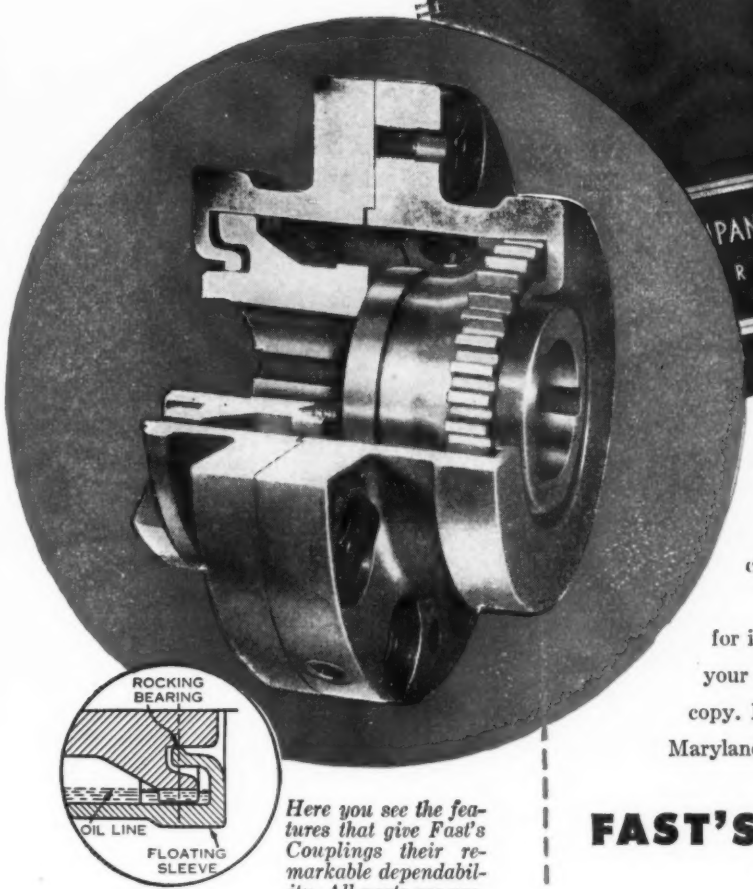
ADAMS AFTERCOOLERS and CYCLONE SEPARATORS

If you use couplings, this book will help you





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FAST'S *self-aligning* COUPLINGS

SAFEGUARD YOUR POWER TRANSMISSION

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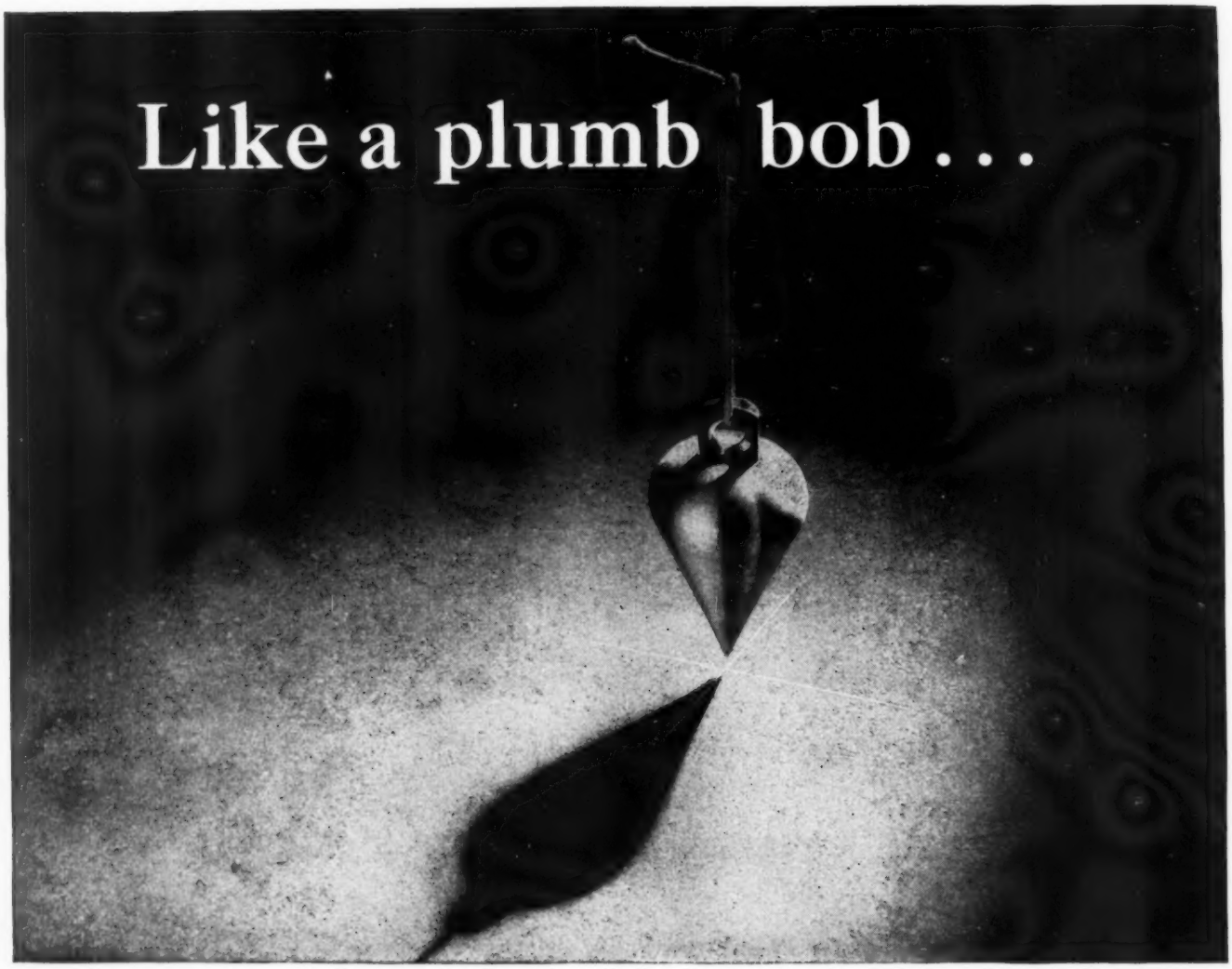

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Because there's nothing to adjust

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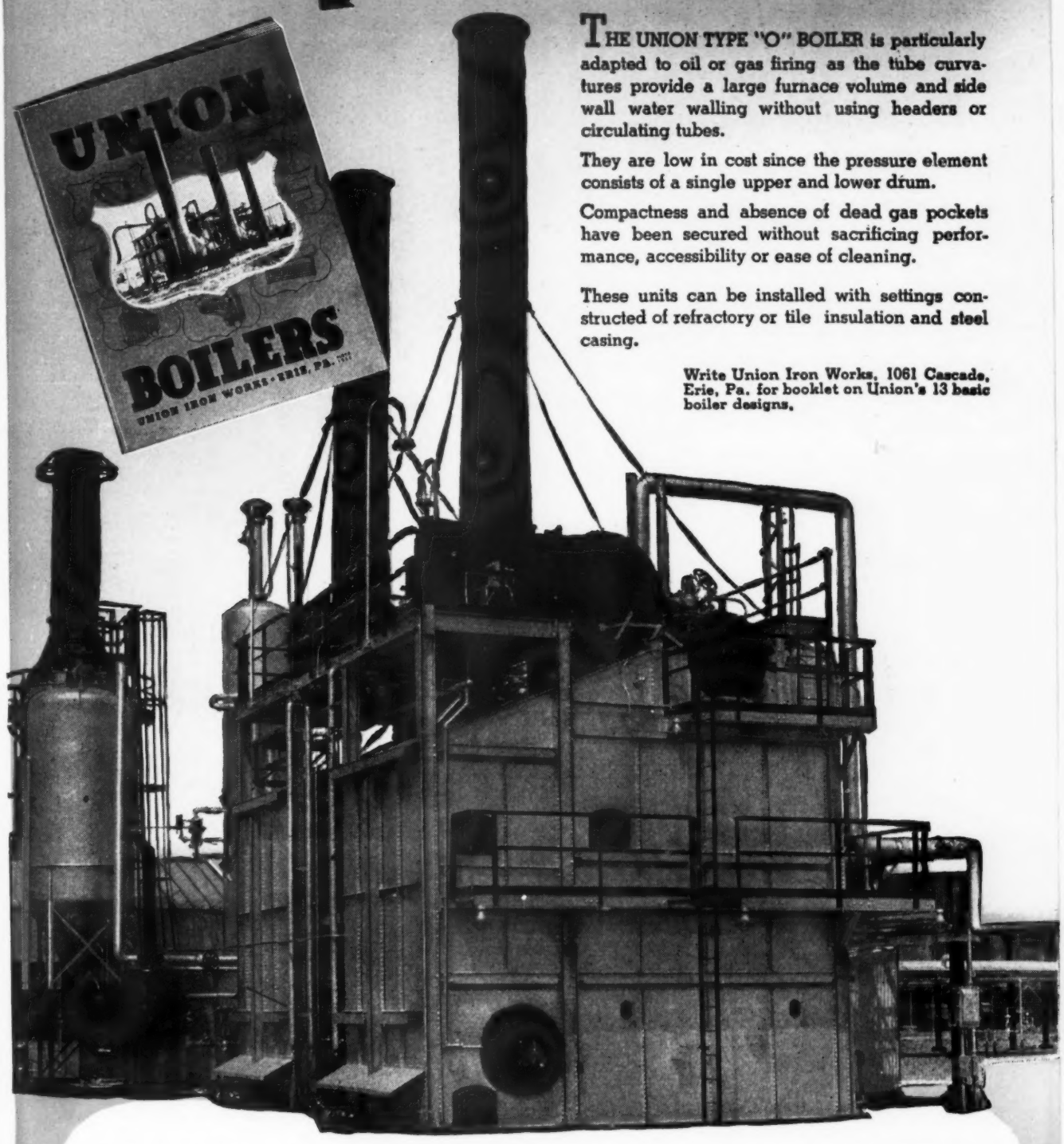

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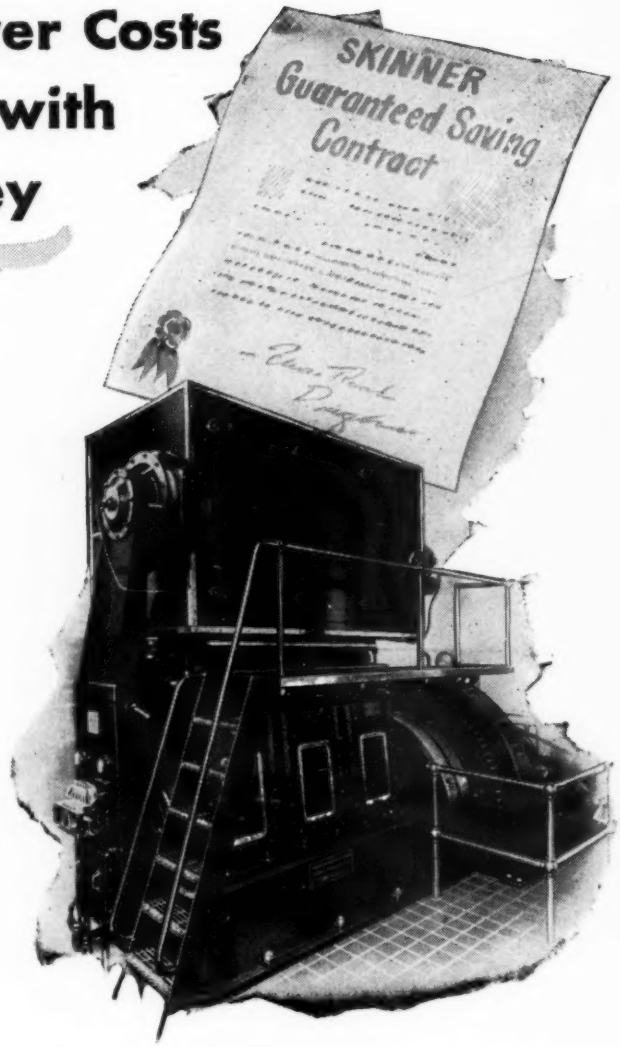

● 600 kw. Multi-Cylinder Vertical "Universal Unaflow" Steam Engine

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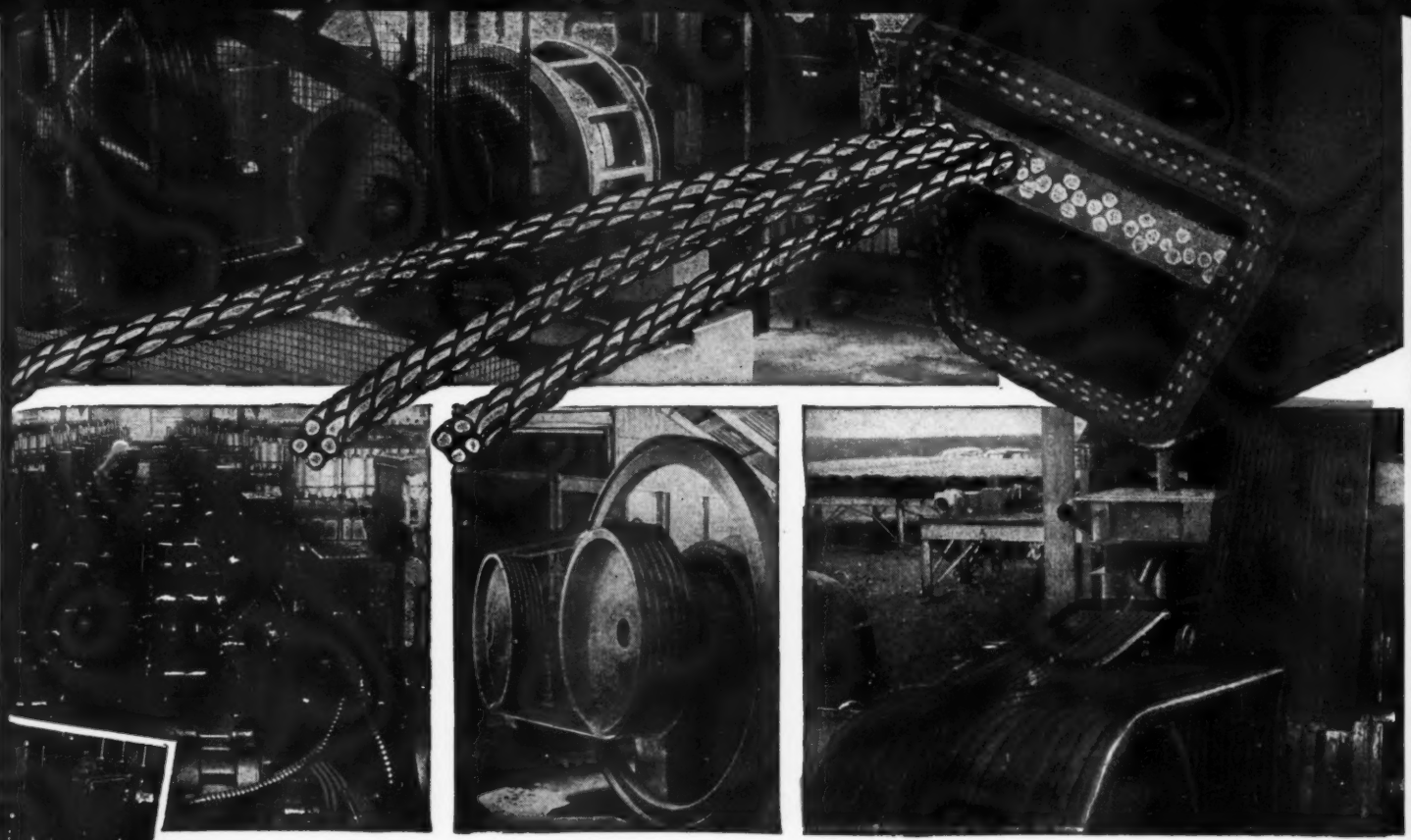

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V-Belt Bulletin #6868B (mailed on request) gives more details of the long-wearing construction and includes helpful tables.

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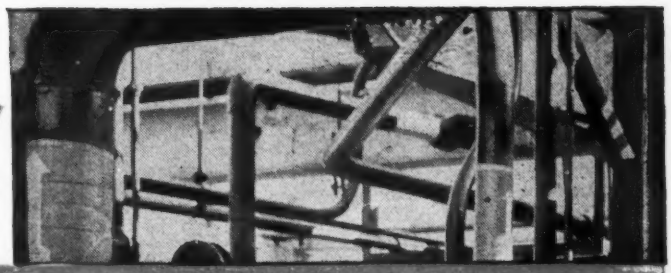
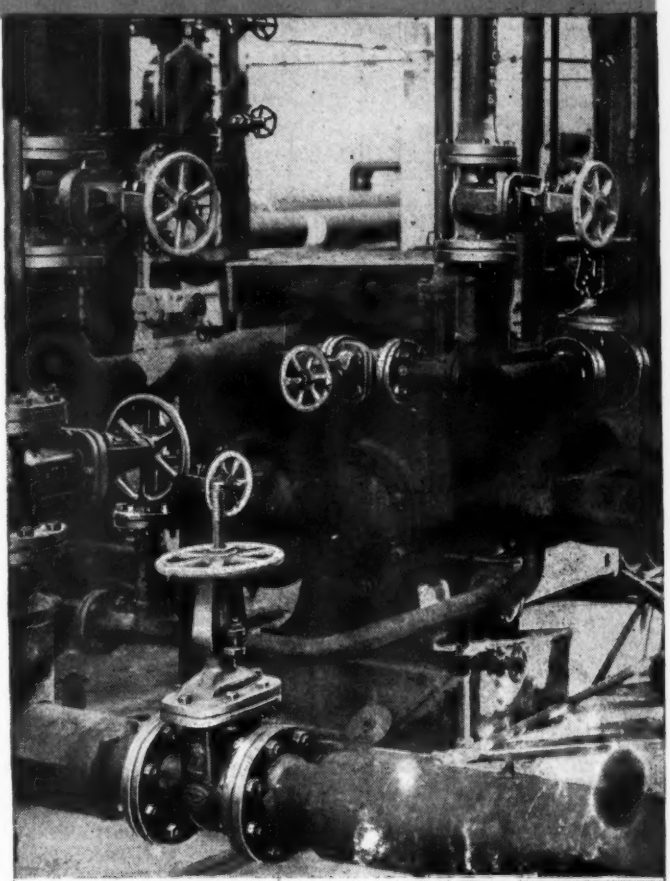
TIGHT VALVES FOR "TIGHT SPOTS"



. . . in the Process Industries

Ordinary valves are in a "tight spot" when they are expected to remain tight in a corrosive fluid pipeline. But Aloyco Stainless Steel Valves take severe conditions in their stride, functioning perfectly day-in and day-out for extraordinarily long periods. The excellence of Aloyco Valves is the result of our pioneering in the design and manufacture of all-stainless-alloy valves. The peculiar properties of stainless alloys call for great skill in the fabrication of products made from them. Specialization in this field has given us a "know-how" that is indispensable in the production of valves which are exceptionally long-lived and low in maintenance cost. Consult us on your requirements for valves in applications where resistance to corrosion and contamination are essential.



Aloyco-20 Valves circulating 60 to 65% sulphuric acid in large synthetic rubber plant.

Aloyco No. 111 Gate —Leader of corrosion resistant valves

ALOYCO

STAINLESS STEEL VALVES AND FITTINGS

GATE, GLOBE, Y, CHECK, TANK, SAMPLING AND V-PORT VALVES
SCREWED, FLANGED AND WELDED FITTINGS

ALLOY STEEL PRODUCTS COMPANY, INC.

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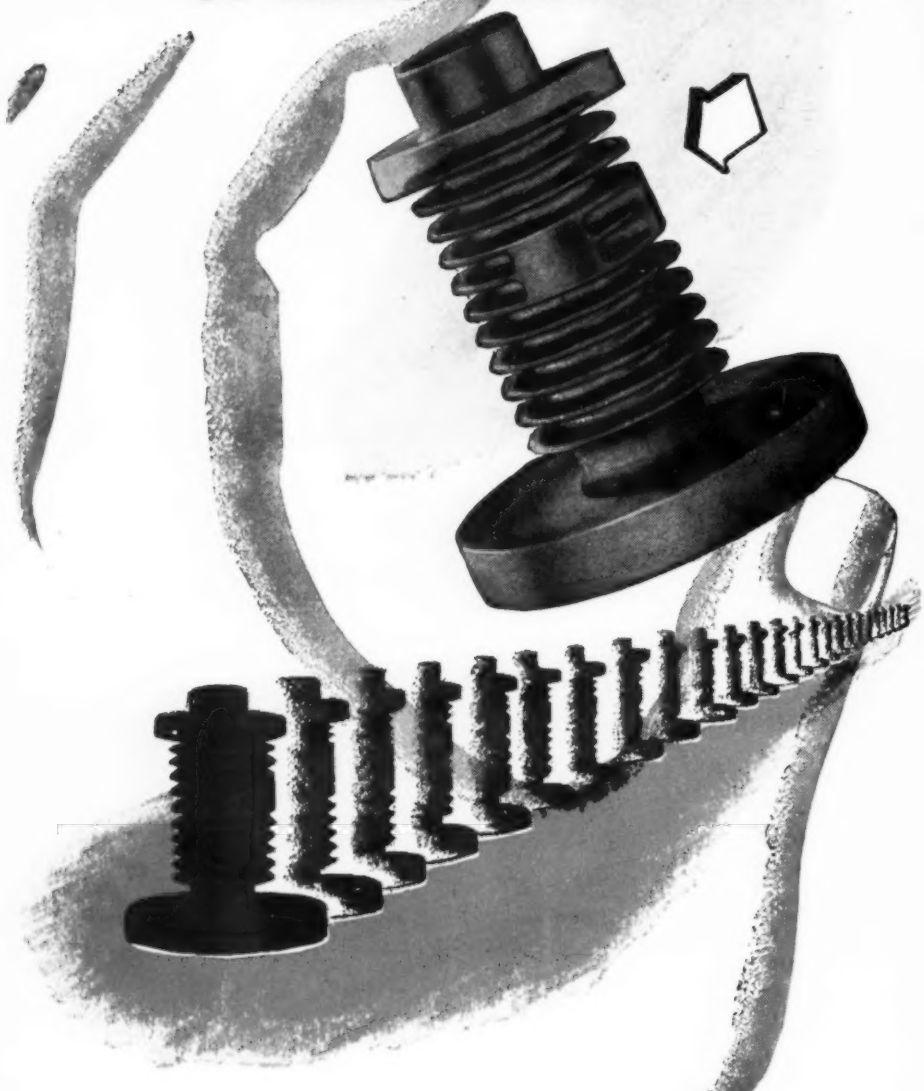
DESCENDED FROM A LONG LINE OF ABLE PERFORMERS



Behind this Sivyer casting is the experience of nearly 38 foundry years. Before it is the promise that it will do its job long and well—will provide the kind of service which the skill from these casting years has put into it.

Men long experienced in every phase of foundry practice carefully watch over the making of all Sivyer Steel castings. And the latest in scientific testing and control work with these men to the end of finished products embracing greater integrity of metal . . . greater dimensional accuracy.

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SIVYER STEEL CASTING COMPANY
MILWAUKEE CHICAGO

Are you getting the GASKET SERVICE You Ought to Get?

If you take gasket troubles for granted, here's a fact that you should know—

Most of those troubles are unnecessary.

Why? Because you're using a gasket that's *almost* right for its particular application. By getting the gasket that's *exactly* right, you get maximum durability, and *100%* joint efficiency.

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	Toronto	Syracuse	

Lowell Thomas Speaks On New Gasket Film

Now available to employee groups, technical societies, engineering schools and other organizations throughout the country, this new 35-minute Kodachrome film, "Only a Gasket," tells why these are the "Biggest little things" in modern industry. Write for full information.

Goetze for GASKETS

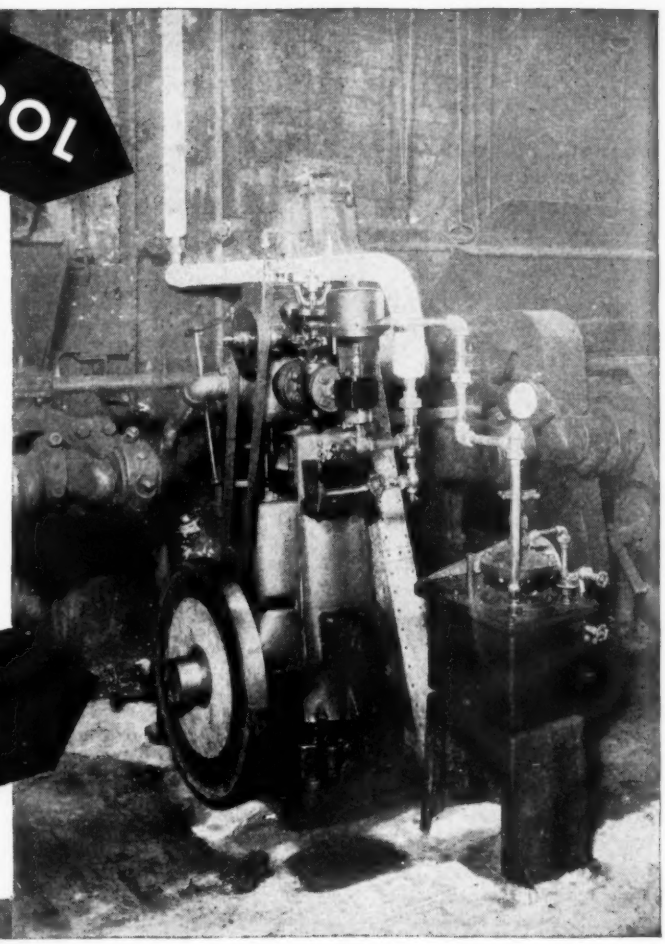
"America's Oldest and Largest Industrial Gasket Manufacturer"

TROY-ENGBERG STEAM ENGINE

CLOSE SPEED CONTROL

IS THIS WHAT *You* WANT?

WIDE SPEED RANGE



The steam engine can idle along or can turn over at top rated speed which is many times the speed of idling or it can be set at any intermediate speed.

This is one reason why you will find Troy Steam Engines on so many stokers, particularly those with widely varying boiler loads. And this same flexibility coupled with close speed control makes the steam engine very useful for driving other equipment which operates with variable speeds.

Industry has plenty of such installations . . . and plenty of use for the modern Steam Engine.

Are you planning to purchase any equipment that requires a drive? Do you have some drives that should be changed? If so, we suggest you investigate the Troy-Engberg Engine.

TROY ENGINE & MACHINE COMPANY
Established 1870
2520 Railroad Avenue Troy, Pennsylvania

Bulletin No. 306 will give you information on the Troy-Engberg Steam Engine. Shall we send you a copy?

TROY-ENGBERG
STEAM ENGINES • GENERATING SETS • GENERATORS

19 Years of Dependability

on DODGE-TIMKEN PILLOW BLOCKS

The Dodge-Timken Pillow Blocks pictured above were installed in the sawmill and lumber manufacturing plant of the Hills Creek Lumber Company of Jasper, Oregon, over 19 years ago. This company selected Dodge-Timken Pillow Blocks because they wanted smooth-running bearings which would give years of dependable service with minimum operating and maintenance expense.

This 19-year record of fine performance is proof again that leading manufacturers specify Timken Bearings in their operating equipment because they know this means greater endurance, reduced operating costs and minimum attention for maintenance.

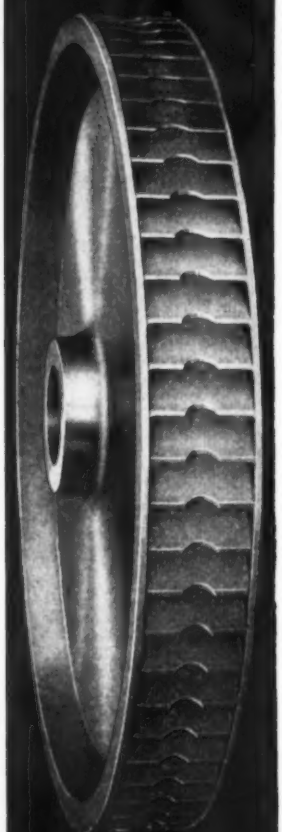
They know that Timken Bearings assure friction-free operation; proven ability to carry radial, thrust and combined loads while holding parts in correct and constant alignment; and simple lubrication.

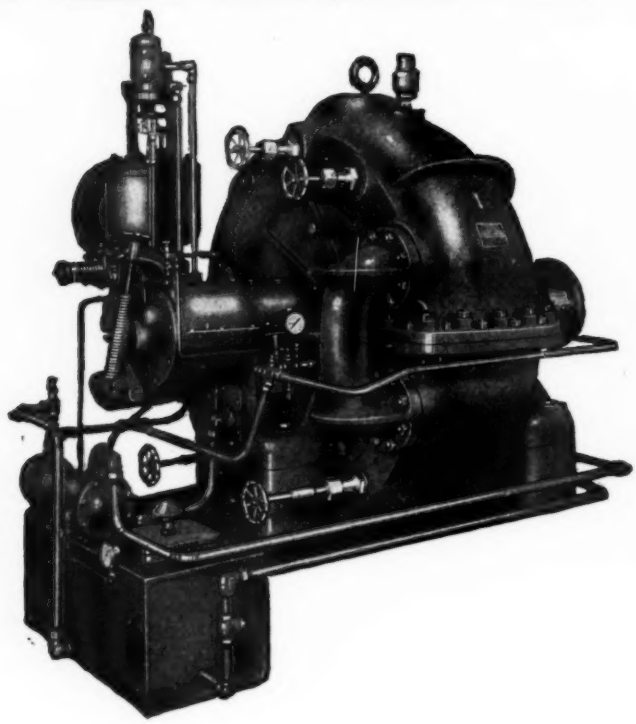
Be sure that the trade-mark "TIMKEN" is stamped on every bearing you use.

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

TERRY





THE WHEEL OF THIS 165 lb. BACK PRESSURE TURBINE IS DOUBLE RIM PROTECTED

The 925 H. P. Back Pressure Turbine shown above employs a Terry Solid Wheel Rotor as shown at the left.

The buckets are protected by rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the clearance became reduced.

With this construction it is impossible for the blades to foul and frequent inspections of the thrust bearings are not required to obtain safe and dependable operation.

The Terry Wheel Turbine is fully described in our Bulletin S-116. A request on your business letterhead will bring a copy.

T-1165

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

POWER

for the world's LARGEST STEEL PRODUCER

BY-

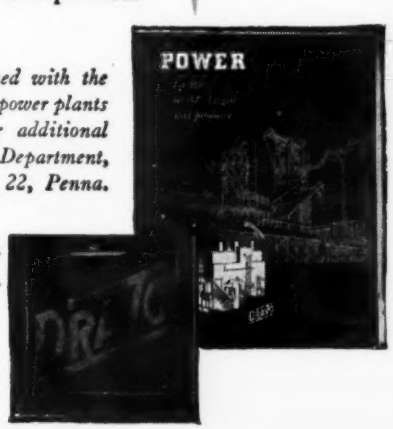
- Power and Boiler Plants
- Pumping Stations
- Power Plant and Contractor's Equipment
- Direct-Fired Heaters
- Industrial Heating and Ventilating
- Bridge Substructures
- Docks
- Pump Houses and Intakes
- Mill Foundations
- Locks and Dams
- Shafts, Slopes and Tunnels
- Towboats and Barges
- Coal and Ore Bridges
- Cranes and Derrick Boats
- Crane Cab Coolers
- Open Steel Flooring
- Concrete Aggregates
- Inland River Transportation

TYPICAL example of the results which you, as a purchaser and operator of power plants, can expect from the application of the DRAVO *Single-Contract Method* of Power Plant Construction is this installation for the Edgar Thomson Works of Carnegie-Illinois Steel Corporation.

☆ The need was urgent, the construction complicated. To relieve its own engineering staff of additional burdens of supervising and coordinating many sub-contracts, Carnegie-Illinois Steel Corporation, acting through Defense Plant Corporation, and the Consulting Engineers decided to place major responsibility with a single contractor.

☆ With more than a half century of experience in the construction of boiler and power plants and the installation of equipment, DRAVO was prepared to accept this responsibility. Under the DRAVO *Single-Contract Method* a definite price and a definite schedule for construction were assured. The reliance on DRAVO experience and responsibility produced tangible results when the construction schedule was maintained to completion and major equipment was put into service approximately six months before the completion date.

Industrialists and Engineers concerned with the construction and operation of boiler and power plants will want to read Bulletin SC-513 for additional details of the success of this project. Power Department, DRAVO CORPORATION, Pittsburgh 22, Penna.



Built by the Machinery Division with Substructure by The Contracting Division

DRAVO CORPORATION

PITTSBURGH • WILMINGTON • PHILADELPHIA
WASHINGTON • NEW YORK
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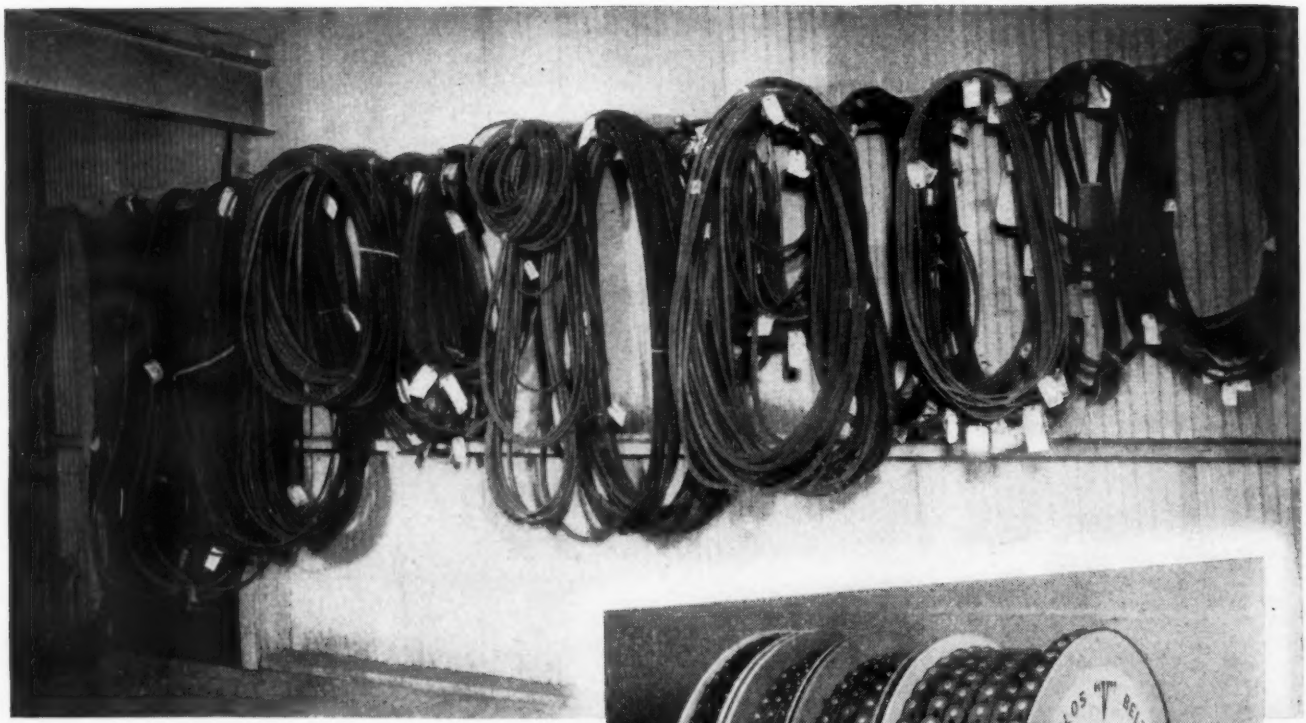
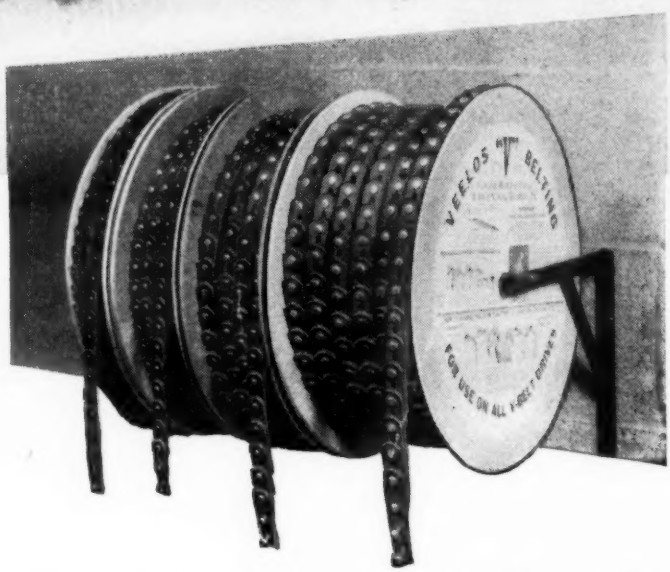




316 sizes OF ENDLESS V-BELTS CAN BE Replaced with only 4 sizes of Veelos

FROM only four widths of Veelos—the link V-belt—you can make up 316 standard sizes of industrial and fractional endless V-belts. There's no need to stock spare sets of endless belts for each drive.

Large, costly inventories are eliminated... no deterioration of spare belts... no obsolescence.

Veelos on reels saves stockroom space... reduces inventory records... *is easy to locate and easy to install.*

Made in all standard sizes... fits all standard V-belt grooves ...available in standard 100-foot reels.

VEELOS
THE LINK
V-BELT
Adjustable to any Length
Adaptable to any Drive

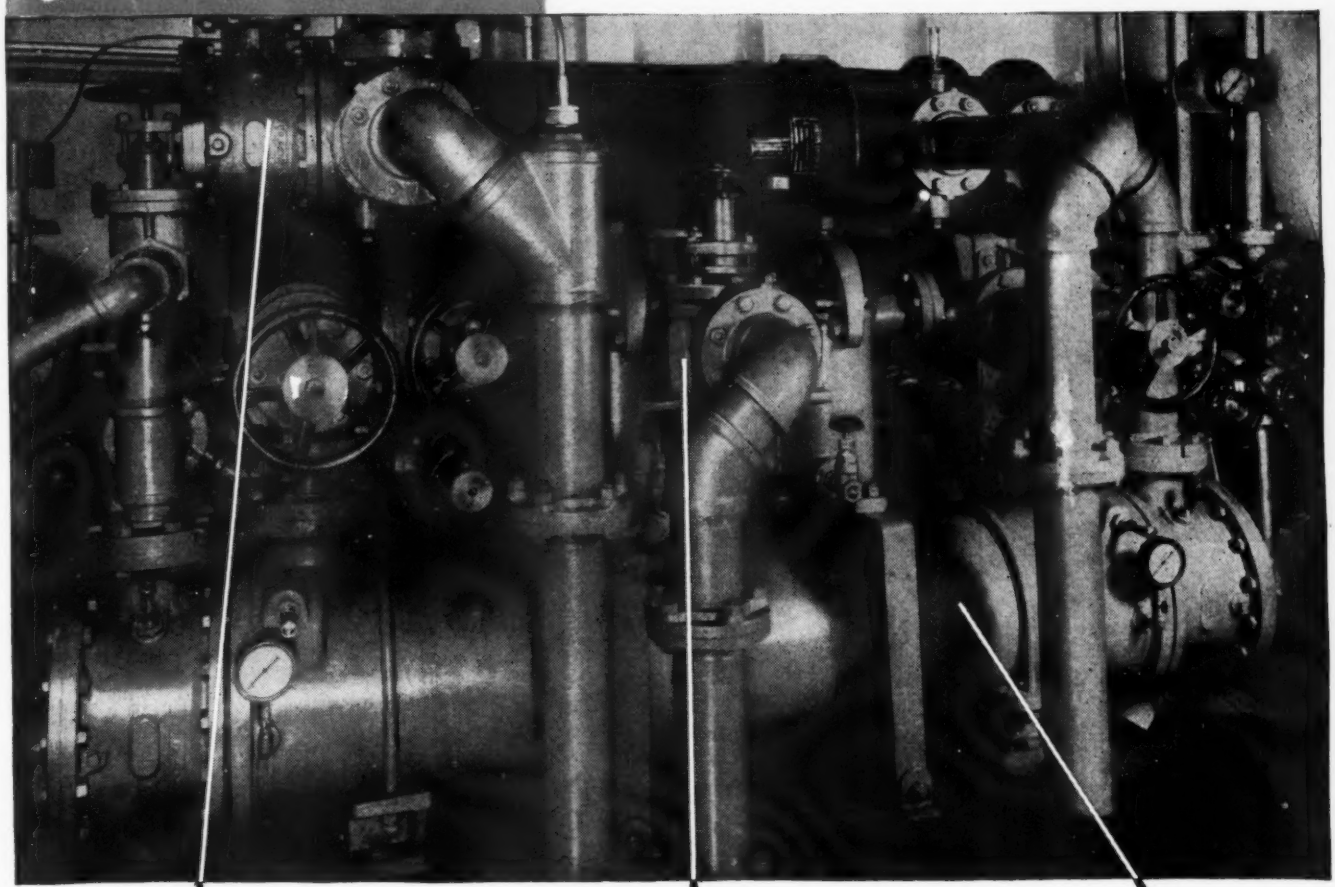
MANHEIM MANUFACTURING & BELTING CO., MANHEIM, PA.

Tested • Proved • Adopted by American Industry

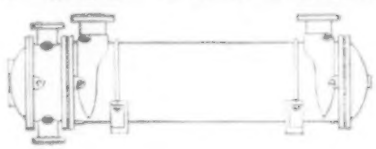
Minimize Out-of-Service Time

. . . . WITH SK DIESEL AUXILIARIES

Where continuous service is important, the heavy walls, corrosion-resistant materials and rugged design of SK Heat Exchangers and Strainers provide unusually long, trouble-free life and require but little maintenance. Designed specifically to meet the individual requirements of each job, these units have a reputation among users for exceptional performance.

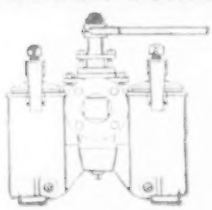


SK OIL COOLERS



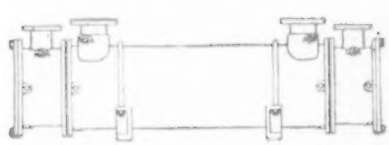
Equipped with a unique packing gland at the floating tube sheet, oil cannot leak to water nor water to oil in these coolers. Baffle rings and discs force liquid into long zig-zag path and a precision-bore fit prevents liquid by-passing between shell and baffle. Easily cleaned without dismantling or disconnecting pipes. Write for Bulletin 12-C.

SK DUPLEX STRAINERS



Heavily constructed, these strainers are thorough in removing dirt and other foreign matter from oil or water. Flow is continuous while cleaning the vertical baskets. Single set screw clamps are quickly removable, yet seal basket chambers tightly. Write for Bulletin 9-S.

SK WATER COOLERS



Similar to SK Oil Coolers in design, these Water Coolers have exceptionally high heat transfer, low weight and small space requirements. The uniform flow of both jacket and cooling water eliminates strains and cracked cylinders caused by uneven distribution of heat. For complete description, write for Bulletin 12-H.

JET APPARATUS • HEAT TRANSFER EQUIPMENT • STRAINERS
CONDENSERS AND VACUUM PUMPS • OIL BURNING EQUIPMENT
ROTAMETERS AND FLOW INDICATORS • RADIAFIN TUBES
VALVES • SPRAY NOZZLES AND ATOMIZERS • GEAR PUMPS

SCHUTTE & KOERTING COMPANY
Manufacturing Engineers
1150 THOMPSON ST. • PHILADELPHIA 22, PA.

"I'll get 'em up somehow"

"I should think so, Herb Palmer! Managing a few storm windows ought to be easy for a man who's been bragging about working 200 feet above the ground on a wax shower . . ."

"It was a dewaxing tower, dear, at that refinery. It was only 150 feet, and . . ."

"Well, for two weeks you've told anybody who'd listen all about the way you put up heat insulation . . . and how wonderful the equipment was Armstrong gave you to work with. And how they had to hoist you up with a wrench . . ."

"That's a winch! And why shouldn't I talk about our equipment? If a guy can't boast a little about the company he works for, he'd better get another job."

"Of course, dear. I'm mighty thankful Armstrong supplies such good equipment when you work so far up in the air. But these windows are only on the first floor . . ."

"Still they'd go up a lot faster if I had a decent ladder . . ."

"All right, dear, all right. Maybe you'd better go downtown and get yourself a new ladder. You'll need it next spring, anyway, when you paint the house."

* * *

Having the right equipment is mighty important, whether the job is large or small. But particularly on the "high work" Herb was doing, equipment makes a tremendous difference. Armstrong makes sure its insulation crews have the safest, most modern equipment to work with. It means a lot to the men, and it means your job gets done quickly and efficiently.

This equipment is ready in all 28 of the major industrial areas where Armstrong maintains insulation warehouses and trained crews of workmen. However complex your heat insulation problem may be, Armstrong is set up to handle it.

Free! New Insulation Chart

If you use insulation, you'll want a copy of a new chart recently developed by Armstrong. This check list shows which kind of insulation, and how much of it, can most profitably be used to hold any given temperature from 300° below zero to 2800° F. For your free copy, write to Armstrong Cork Company, Industrial Insulation Dept., 7010 Maple Ave., Lancaster, Pa.

ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service For All Temperatures

From 300° Below Zero

To 2600° Fahrenheit

Remember this trademark

Liquon

when you have a

WATER CONDITIONING PROBLEM *it means...*

Authoritative Advice . . .

because offered by recognized leading water-conditioning experts and pioneers, with more than a quarter century of experience in this field.

Impartial Recommendations...

because LIQUON Processes and Equipment are not limited in scope . . . they include every process and every type of apparatus for softening, demineralizing and clarifying water and other liquids.

Complete Service . . .

because the LIQUON organization is prepared to analyze your specific problem and to furnish the ion-exchange materials, process and entire treating system to meet your particular requirements.

Most Effective Results . . .

because LIQUON methods, materials, and apparatus are the most modern in the art, and each installation carries an overall guarantee of performance.

It will pay you well to consult the LIQUID CONDITIONING engineers. Your request for advice and recommendations will not involve the slightest obligation on your part and may develop unexpected possibilities for improvements and greater economy in your water-conditioning operations.

LC-101

LIQUID CONDITIONING CORPORATION
423 West 126th Street, New York 27, N. Y.

Processes

FOR WATER CONDITIONING

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Hardness, Turbidity, Color, Odor, Taste, Iron, Silica, Oil, Total Dissolved Salts, Oxygen, Other Gases

FOR OTHER LIQUIDS

Removal of

Undesired Impurities from Syrups, Juices and Chemical Solutions

Recovery of

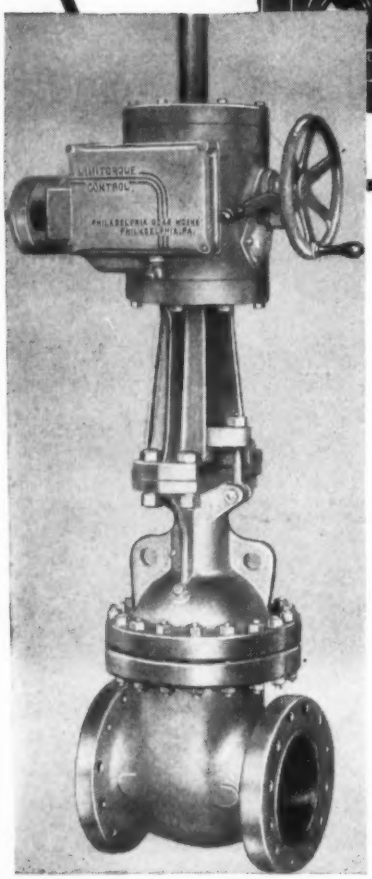
Valuable Substances from Solution or Suspension

Products

Chemical Products and Mechanical Equipment for Water Conditioning for Household, Industrial and Municipal Use; also for Conditioning of Other Liquids:

Cation and Anion Exchangers
Zeolite Water Softeners
Ion Exchange Equipment
Demineralizing Equipment
Filtration Equipment
Diatomite Filters
Chemical Feeds
Sludge Blanket Units
Cold Lime-Soda Softeners
Hot Process Softeners
Continuous Blowoff Systems
Deaerating Heaters
Vacuum Deaerators

Push-Button CONTROL OF VALVES WITH Limitorque VALVE OPERATOR



The "Limitorque" (at left) is for valves working at low to medium temperatures, low to high pressures, and normal speed of operation.

This Unit is mounted on top of valve yoke . . . no extra gears, nuts or bearings required. Stem nut is inside and furnished with Unit. Nut is directly inside worm gear which drives it. (All clutches and connecting sleeves are eliminated.)

Limitorque is designed for plug, cock, gate and globe valves . . . Entire Unit and nut can be lifted off valve yoke, by removing flange bolts, without disturbing wiring.

A special high starting torque motor, reduction gears, limit switches all in one weatherproof assembly, — and all electrical connections are made to one terminal board, easily accessible by removal of watertight cover. . . . Heat treated helical gears and hardened, ground and polished worm and bronze worm gear are used.

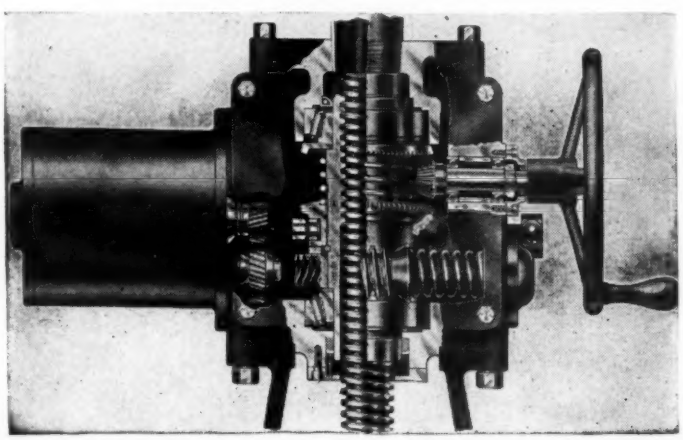
A handwheel is provided for manual operation and does not revolve during motor operation. During hand operation motor is mechanically disengaged. Limitorque is always operative electrically. No danger to operator should he be turning handwheel when motor is started, since automatic clutch disengages handwheel instantly, without shock. Declutch lever changes from motor to hand operation. The usual Limitorque "hammerblow" device allows motor to reach full speed before load is engaged. This imparts the "hammerblow" necessary to unseat sticking valve.

Torque seating switch insures tight valve closure without strain on valve parts. Protection from damage due to a foreign object obstructing closing is provided, because motor is shut off by thrust exerted on valve disc. Valve is protected during entire closing operation.

FEATURES OF THE "SM" TYPE LIMITORQUE

1. Micrometer torque seating switch.
2. Self-contained unit — no gears, nut or bearings to buy.
3. Weatherproof, dust-tight and watertight construction.
4. Hammerblow device.
5. Non-rotating handwheel built into the unit.
6. Automatic declutching.
7. One terminal board for all electrical connections.
8. High torque motors.
9. Simple valve yoke.

The Word "Limitorque" has a definite meaning because an exclusive patented Torque Switch actually limits the torque applied to the operating parts.



Motor is coupled to worm shaft through helical gears. In closing, worm drives worm gear until lugs on the gear meet matching lugs on clutch. Torque is transmitted to the nut through splines connecting the clutch to stem nut. Torque spring is then compressed by axial movement of worm on worm shaft. When torque spring has been compressed to predetermined setting, torque switch is actuated by a tripping collar on worm shaft. This interrupts current to holding coil of controller and stops motor. Inertia of motor is absorbed in further compression of the torque spring. Opening travel is governed by geared limit switch.

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NEW YORK • PITTSBURGH • CHICAGO . . . IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

TO MAINTAIN EFFICIENT OPERATION

USE GENUINE JEFFREY REPLACEMENT PARTS!

Every part, those shown and many more, are built to the same high standards that govern original equipment, plus any new improvements Jeffrey Engineers and Metallurgists are constantly developing.

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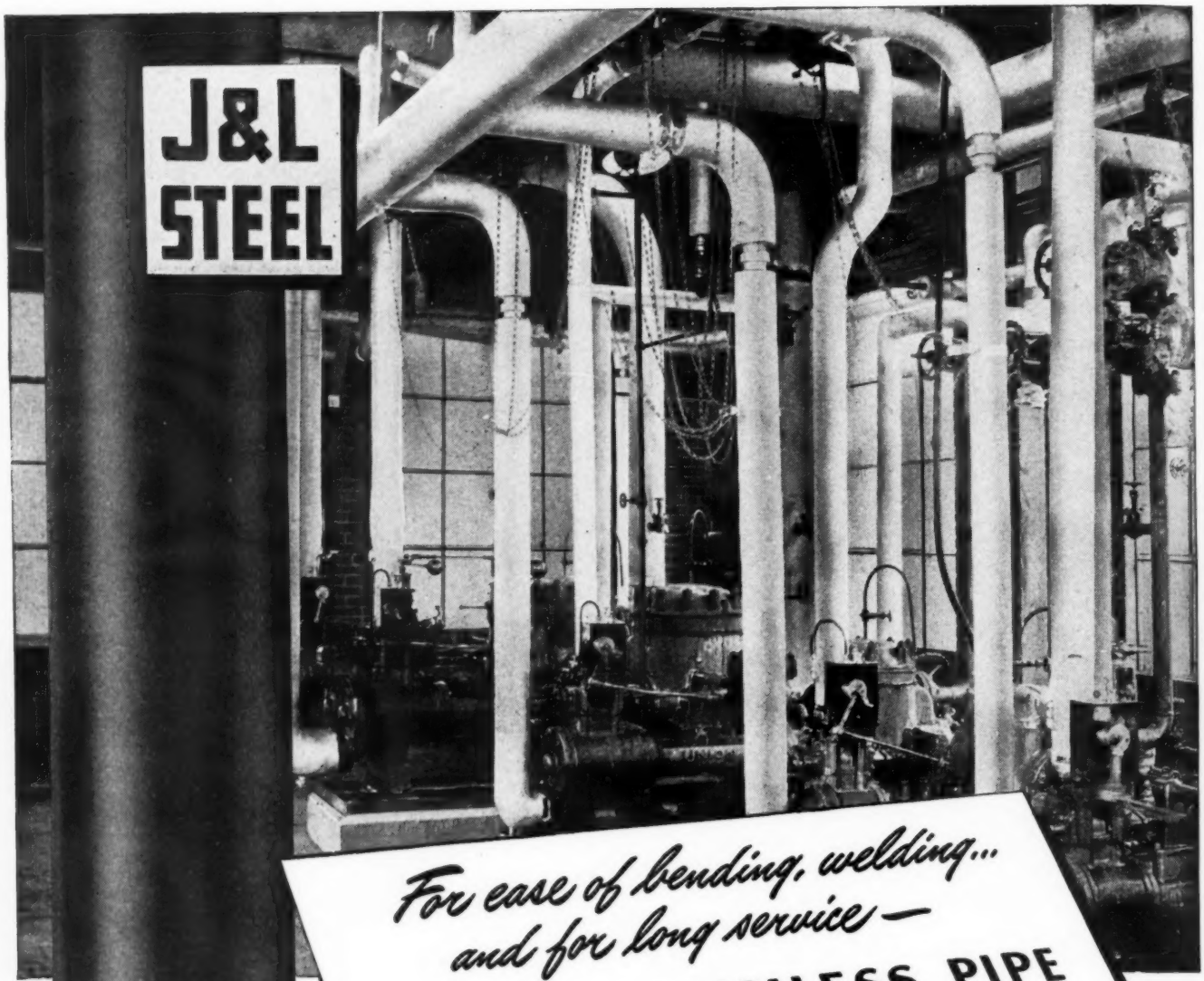


For ease of bending, welding... and for long service—

USE J&L SEAMLESS PIPE

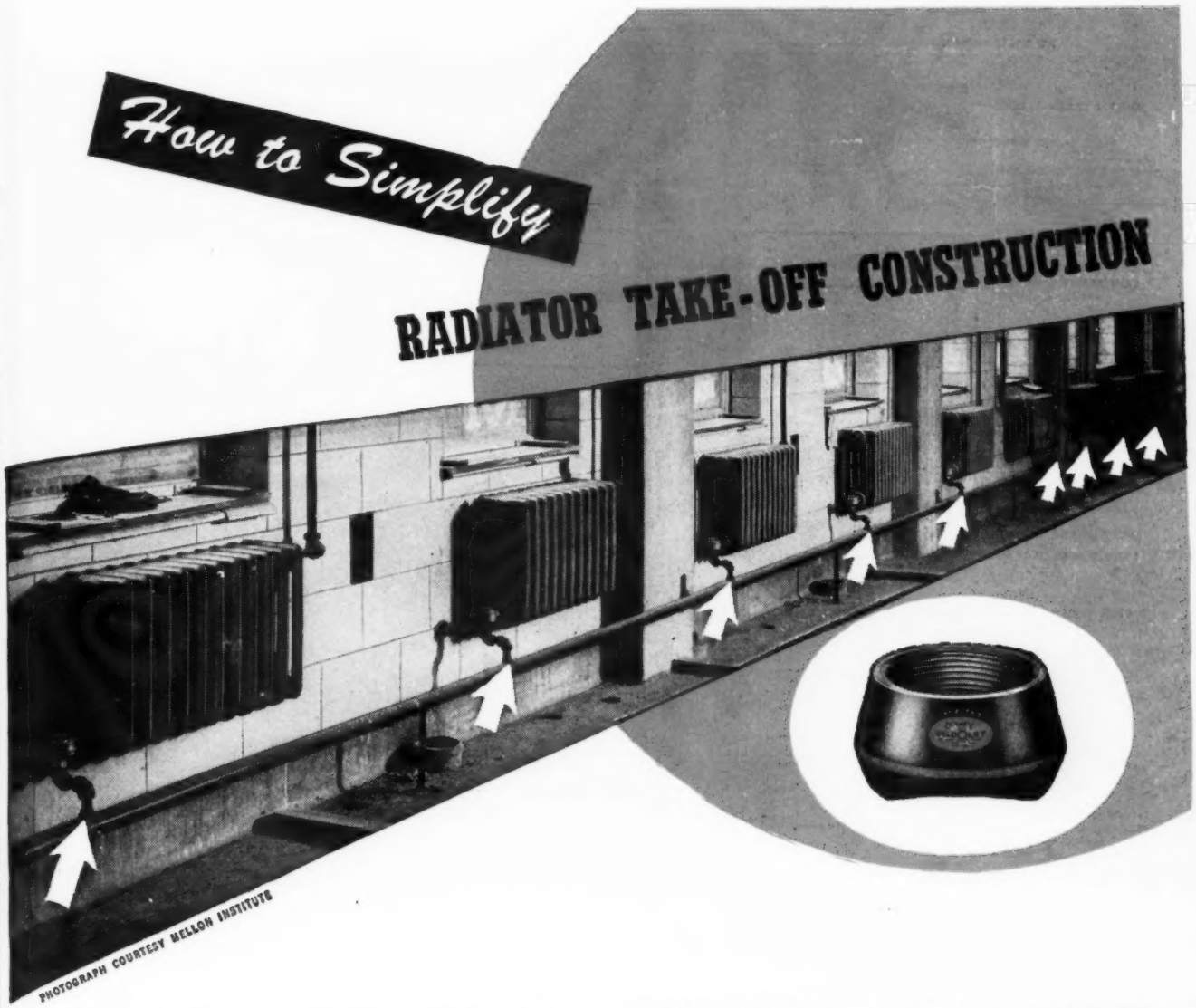
The J&L Controlled Quality steel in J&L steel pipe provides a pipe especially well adapted for power plant installations. In its bending and welding qualities, uniform wall thickness, straightness and inherent strength you have all the properties that make for exacting installations and long and satisfactory service life. Write for further information.

JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH 30, PENNSYLVANIA

How to Simplify

RADIATOR TAKE-OFF CONSTRUCTION



PHOTOGRAPH COURTESY MELLON INSTITUTE

● This illustration shows clearly how the installation of these nine radiators was simplified by using WeldOlet Fittings for making the branches to each radiator.

The use of these fittings made it unnecessary to cut and thread the run pipe for each take-off. Instead, the entire line was laid in position, holes cut in the run pipe with a torch and the WeldOlet Fittings welded in place. WeldOlet Fittings with threaded outlets were used further simplifying the assembly of the branch line.

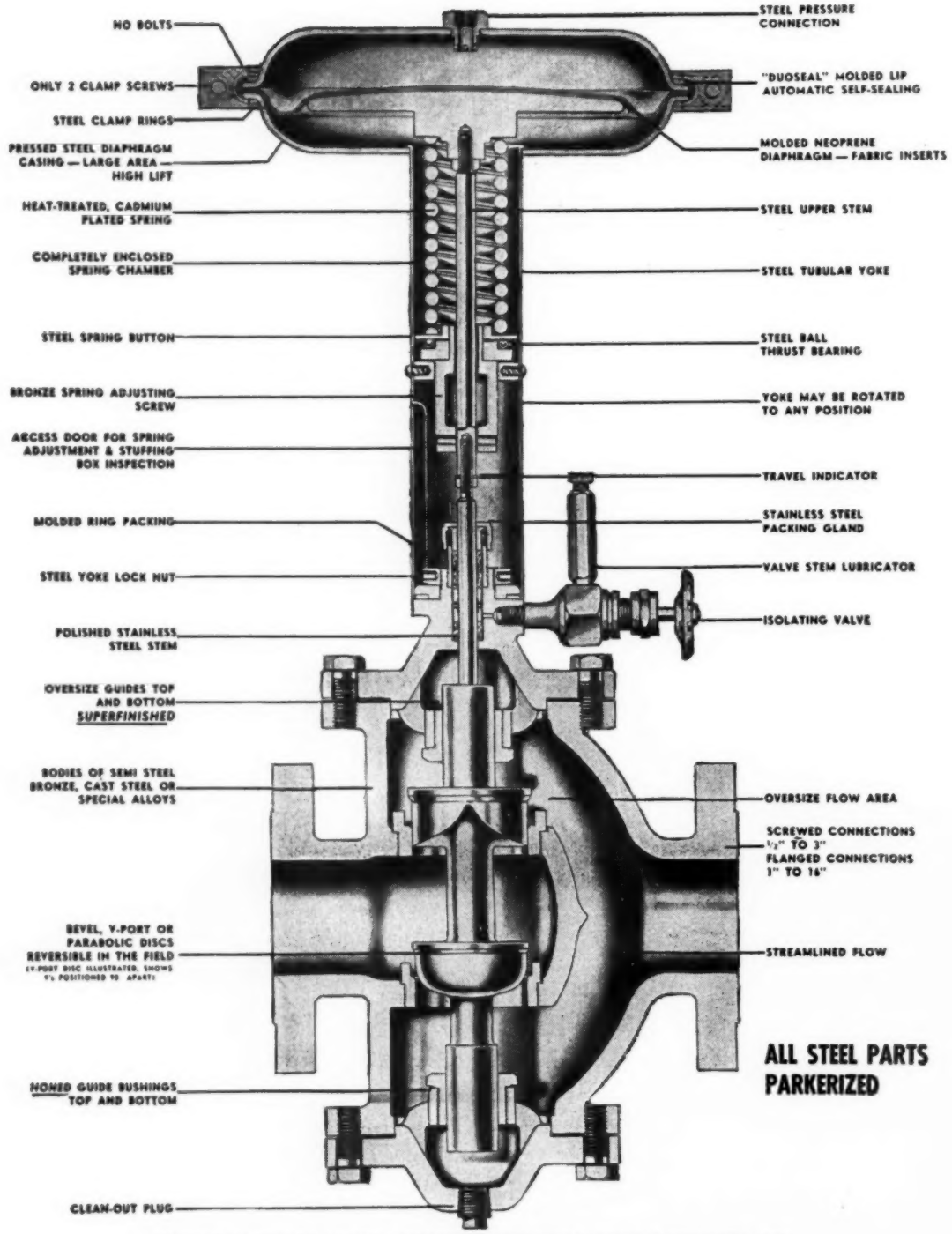
In addition to simplifying the job, the use of these fittings provided leakproof joints of full pipe strength. WeldOlet Fittings also provided improved flow conditions into each branch because of their exclusive funnel-shaped inlet.

On your next heating or other piping job, it will pay you in time, money, performance and permanence to use WeldOlet Fittings for making your branch pipe outlets. To get complete information on these modern fittings, write today for a copy of the new WeldOlet Fittings Catalog. It will give you complete data on their applications and specifications.

Forged Fittings Division

BONNEY FORGE & TOOL WORKS • 342 *Green Street, Allentown, Pa.*

WELDOLETS
TRADE MARK REG. U. S. PAT. OFF.
PAT. IN U. S. & FOREIGN COUNTRIES
WELDING OUTLET - THREADED OUTLET - SOCKET OUTLET
For Welded Branch Pipe Outlets


NO BOLTS
ONLY 2 CLAMP SCREWS
STEEL CLAMP RINGS
PRESSED STEEL DIAPHRAGM CASING — LARGE AREA — HIGH LIFT
HEAT-TREATED, CADMIUM PLATED SPRING
COMPLETELY ENCLOSED SPRING CHAMBER
STEEL SPRING BUTTON
BRONZE SPRING ADJUSTING SCREW
ACCESS DOOR FOR SPRING ADJUSTMENT & STUFFING BOX INSPECTION
MOLDED RING PACKING
STEEL YOKE LOCK NUT
POLISHED STAINLESS STEEL STEM
OVERSIZE GUIDES TOP AND BOTTOM SUPERFINISHED
BODIES OF SEMI STEEL BRONZE, CAST STEEL OR SPECIAL ALLOYS
BEVEL, V-PORT OR PARABOLIC DISCS REVERSIBLE IN THE FIELD
(V-PORT DISC ILLUSTRATED, SHOWS V's POSITIONED 90 APART)
HONED GUIDE BUSHINGS TOP AND BOTTOM
CLEAN-OUT PLUG
STEEL PRESSURE CONNECTION
"DUOSEAL" MOLDED LIP AUTOMATIC SELF-SEALING
MOLDED NEOPRENE DIAPHRAGM — FABRIC INSERTS
STEEL UPPER STEM
STEEL TUBULAR YOKE
STEEL BALL THRUST BEARING
YOKE MAY BE ROTATED TO ANY POSITION
TRAVEL INDICATOR
STAINLESS STEEL PACKING GLAND
VALVE STEM LUBRICATOR
ISOLATING VALVE
OVERSIZE FLOW AREA
SCREWED CONNECTIONS ½" TO 3"
FLANGED CONNECTIONS 1" TO 16"
STREAMLINED FLOW
ALL STEEL PARTS PARKERIZED

DIAPHRAGM MOTOR VALVES, PRESSURE REGULATORS, PUMP GOVERNORS, ETC.

SOMETHING NEW HAS BEEN ADDED

Write for new Kontrol Motor bulletin. Send us your control problems.

KONTROL KIELEY & MUELLER MOTOR

KIELEY & MUELLER, INC., North Bergen, N. J.

4 REASONS WHY

REPUBLIC ELECTRUNITE TUBES

GO IN FASTER-STAY IN LONGER

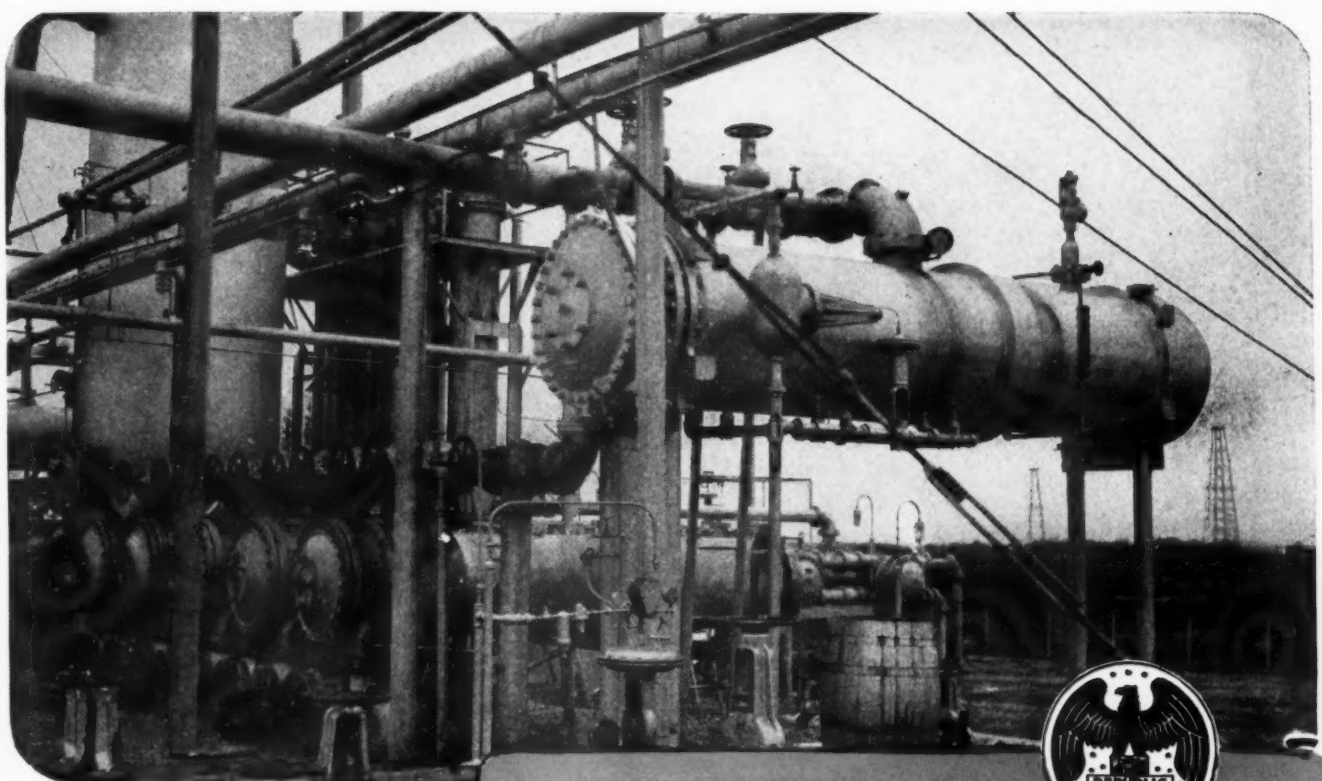
Republic ELECTRUNITE Heat Exchanger and Condenser Tubes offer you four distinct advantages—advantages which speed-up retubing of needed equipment . . . which lengthen time between retubings.

Here they are:

1. **CONSISTENT UNIFORMITY**—in wall thickness, diameter and concentricity—due to Republic's *improved* process of electric resistance welding.
2. **HIGH DUCTILITY**—resulting from full normalizing of every tube—increases ease of expanding, rolling and beading . . . means tight, non-leaking joints in a hurry.
3. **SMOOTH, CLEAN SURFACES**—free from trouble-inviting scale and scale-pits—because these *modern* tubes are cold-formed from flat-rolled steel, both sides of which are carefully inspected before processing.
4. **COMPLETE SAFETY**—proved by a rigid routine of tests, including hydrostatic test of every tube at pressures in excess of code requirements.

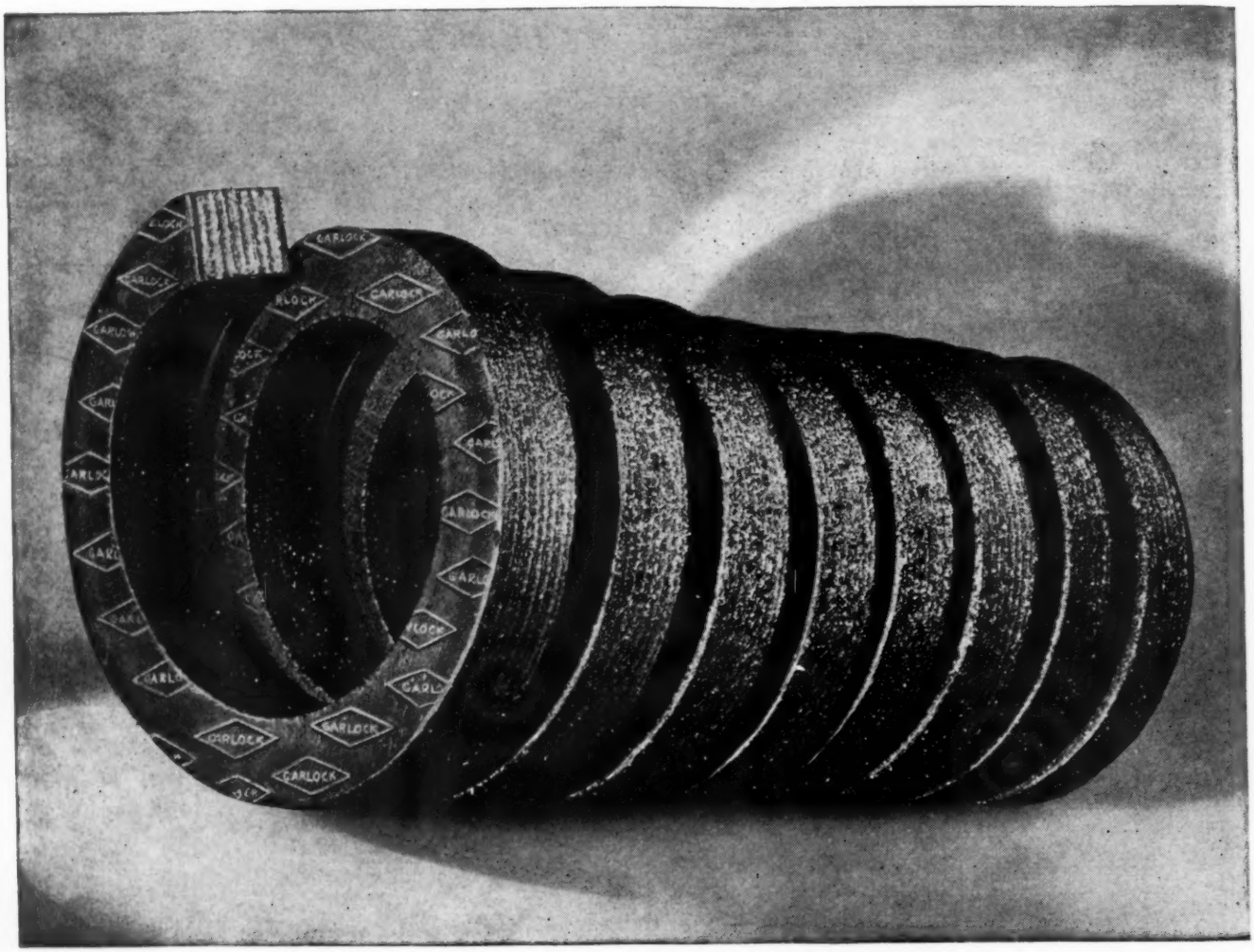
Don't underestimate the importance of using highest quality tubes in your condensers and heat exchangers. Play safe—and save money—by specifying Republic ELECTRUNITE the next time you order carbon or stainless steel tubes. For further information, write to:

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York



Republic ELECTRUNITE Tubes are made from highest quality flat-rolled steel, both sides of which are open to close visual inspection. Thus the surface which becomes the inside wall when formed into tubing is free from hidden defects.

Republic ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES



"An Excellent Low Pressure Packing"

That's a typical comment from thousands of engineers who have used GARLOCK 777 for many years. It is the accepted standard rubber and duck packing for hot and cold water, and for low pressure steam. Use GARLOCK 777 on piston and valve rods of engines and on rods and plungers of reciprocating pumps.

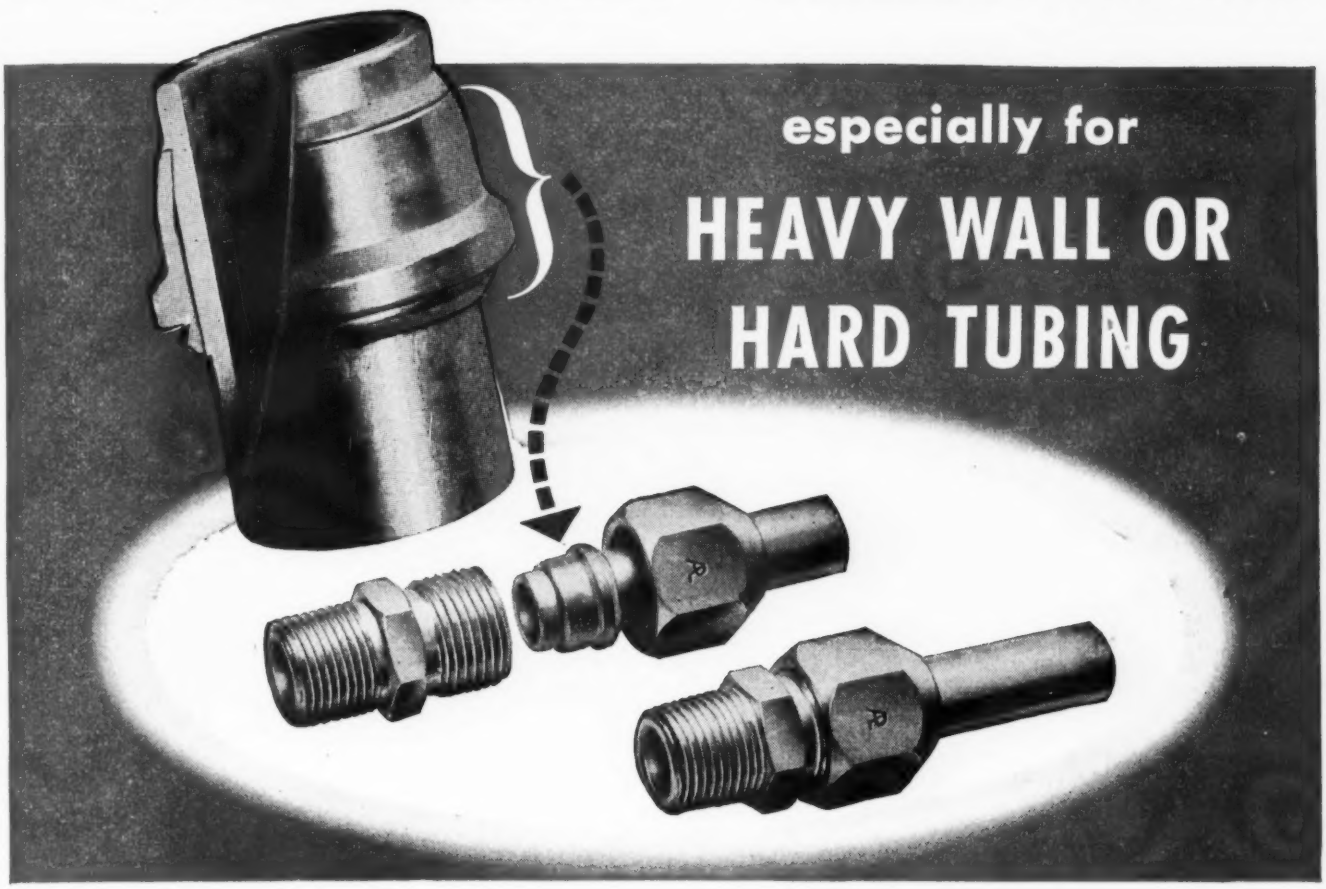
GARLOCK 777 Spiral illustrated above, for hot and cold water, and low pressure steam. (For ammonia specify GARLOCK 778) Ring form—GARLOCK 333 for water and steam—and GARLOCK 334 for ammonia.

THE GARLOCK PACKING COMPANY, PALMYRA, N. Y.
In Canada: The Garlock Packing Co. of Canada, Ltd., Montreal, Que.

GARLOCK 777

FERULOK

THE NEW PARKER FLARELESS COUPLING



Here's a positive joint for all types of metal tubing—any wall thickness—even hard stainless steel.

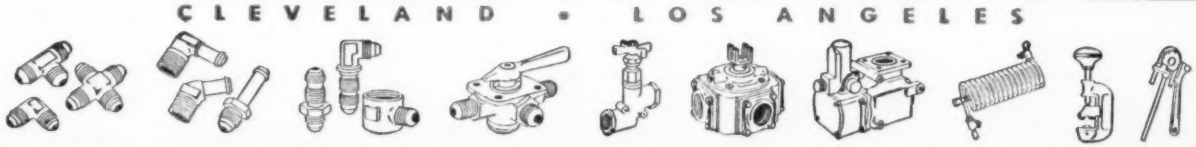
The steel ferrule makes a controlled cut to form a shoulder on the *outside* of the tube wall. In this way a *permanent* seal is provided, regardless of draw marks or surface scratches on the tubing. When the nut is first pulled up, the ferrule cuts into the tube and locks—to form a *permanent* joint which will not leak, even after repeated reassembly. The joint is self-centering—a tight seal is assured even where tube wall thickness is not perfectly uniform.

When you want the safest in vibration-proof, high pressure flareless couplings get Parker Ferulok Flareless Couplings—at your jobbers—or write us direct for complete catalog information. The Parker Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio. In Canada: Railway & Power Engineering Corporation, Limited, Montreal, P. Q.

Look for this famous trade mark. ALP, the initials of our founder, A. L. Parker, will remind you that for Alignment, Leak-protection and Pressure-tightness you can't beat Parker couplings and valves.

THE PARKER APPLIANCE CO.

CLEVELAND • LOS ANGELES



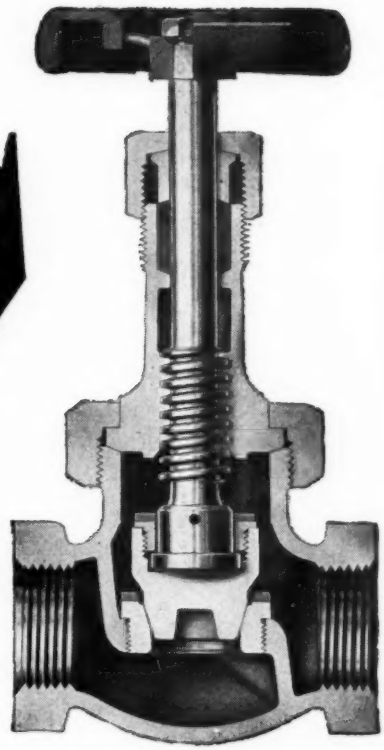
FLUID POWER PRODUCTS FOR ALL INDUSTRY

Every feature you want in a

BRONZE GLOBE VALVE

with Plug-Type Disc

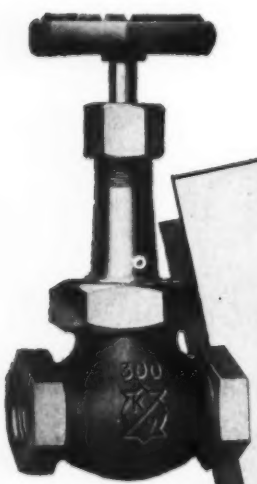
is in the KENNEDY DESIGNS



This Kennedy design brings precision throttling control to the threaded stem type of globe and angle valve. The extra-wide seating surface and the Kennedy Higher-Strength Nickel-Copper Alloy used for both disc and seat ring combine to resist the destructive action of wire drawing and foreign particles; and the disc swivels on the stem to help tight and free seating. Extra assurance of correct seating is provided by matching the renewable seat ring to the disc in each valve.

This Kennedy design is available in a full range of standard sizes for either 200 lb. or 300 lb. steam pressure at 550°F., with corresponding cold water, oil or gas pressures of 400 lb. and 600 lb. They are fully described in the 240-page Kennedy Catalog which shows the entire line of Kennedy iron body and bronze gate, globe, angle and check valves, malleable iron and bronze screwed pipe fittings and cast iron flanged fittings and flanges. Your copy will be sent on request.

Buy From Our Distributor



YOU WANT THESE VALVE FEATURES

. . . you'll find them in this KENNEDY design

1. **Generous Strength . . .** Body and bonnet are of high-grade dense metal with ample thickness and rounded fillets. Stem has large diameter and extra large number of contact threads.
2. **Easy Operation . . .** Stem and stem contact surfaces are accurately threaded. Deep stuffing boxes permit tightness without undue pressure on packing. Large handwheel gives firm, comfortable grip.
3. **Lasting Tightness . . .** Discs and seats seat accurately, and their sturdy design resists distortion and has special provisions for take-up of wear.
4. **Long Life . . .** Many Kennedy valves have been in daily use a quarter century and more.
5. **Convenient Repacking . . .** Glands and packing are easily accessible.
6. **Economical Maintenance . . .** Long wear built into all parts, and adjustments or other attention are seldom required.

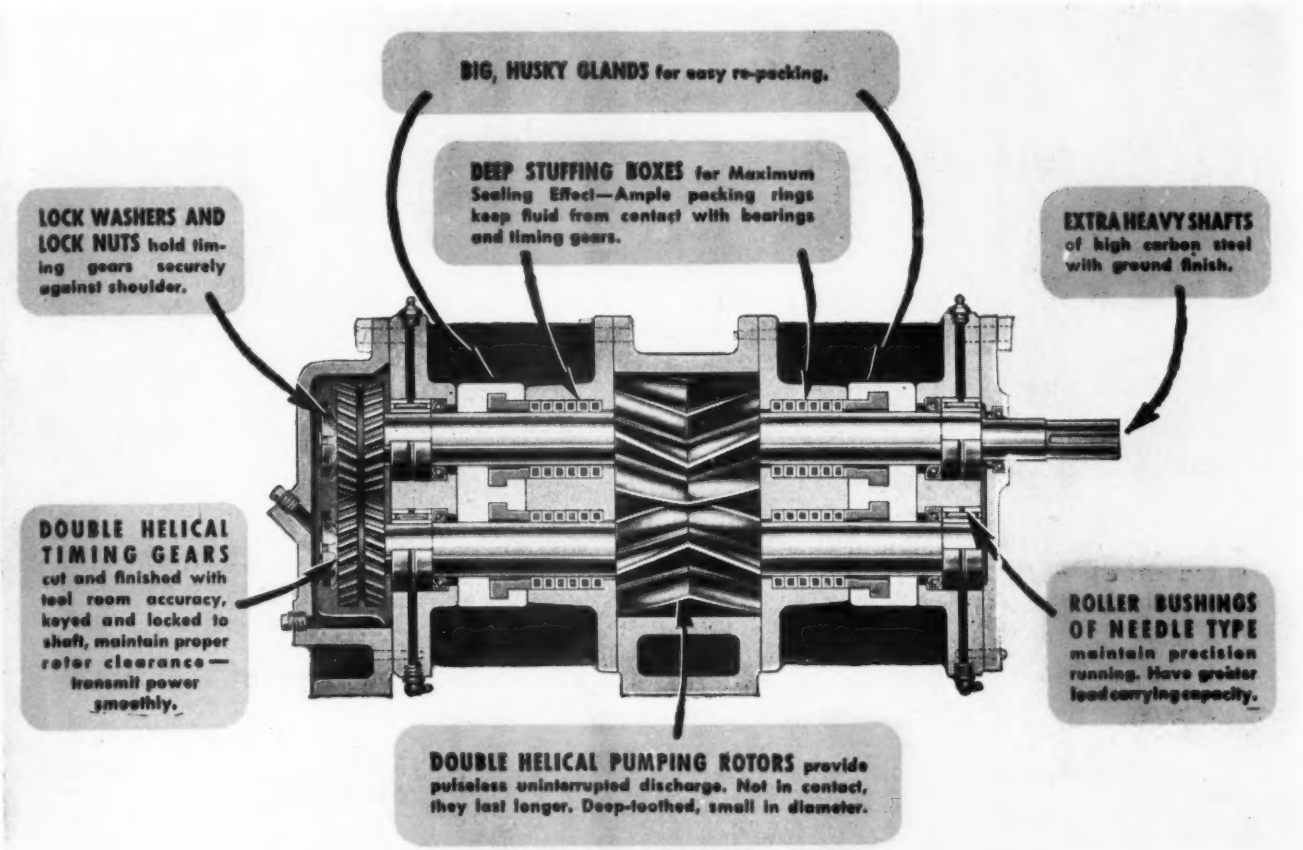
THE KENNEDY VALVE MFG. CO.
Elmira, New York

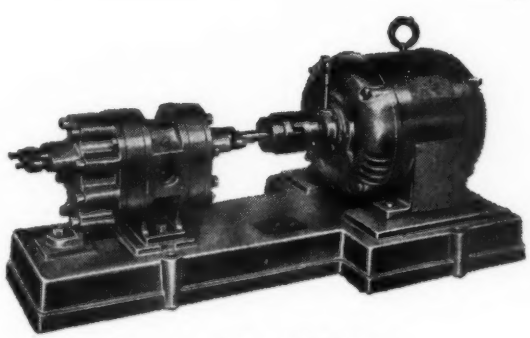
KV-136

KENNEDY *valves - pipe fittings - fire hydrants*

GEAREX ROTARY PUMPS

Give you these PLUS VALUES


BIG, HUSKY GLANDS for easy re-packing.
DEEP STUFFING BOXES for Maximum Sealing Effect—Ample packing rings keep fluid from contact with bearings and timing gears.
LOCK WASHERS AND LOCK NUTS hold timing gears securely against shoulder.
EXTRA HEAVY SHAFTS of high carbon steel with ground finish.
DOUBLE HELICAL TIMING GEARS cut and finished with tool room accuracy, keyed and locked to shaft, maintain proper rotor clearance—transmit power smoothly.
ROLLER BUSHINGS OF NEEDLE TYPE maintain precision running. Have greater load carrying capacity.
DOUBLE HELICAL PUMPING ROTORS provide pulseless uninterrupted discharge. Not in contact, they last longer. Deep-toothed, small in diameter.



MADE IN EXTERNAL AND INTERNAL BEARING TYPES

PUMP : Oils, varnishes, solvents, molasses, chemical solutions

•

CAPACITIES: 1 to 550 g.p.m.

•

DISCHARGE: 250 p.s.i. for medium or high viscosities. 50 p.s.i. for water

•

For higher pressures and capacities use
SIER-BATH SCREW PUMPS

SIER-BATH Gearex Rotary Pumps last longer and run quieter because they are made to the same high accuracy standards as Sier-Bath Precision Gears. Their low pitch line speed results in more efficient operation. Their special design prevents trapping. Sier-Bath Gearex Pumps are available in horizontal and vertical models, in steel or special alloys, and with jacketed bodies for high temperature applications or where heat must be applied. Write for detailed information.

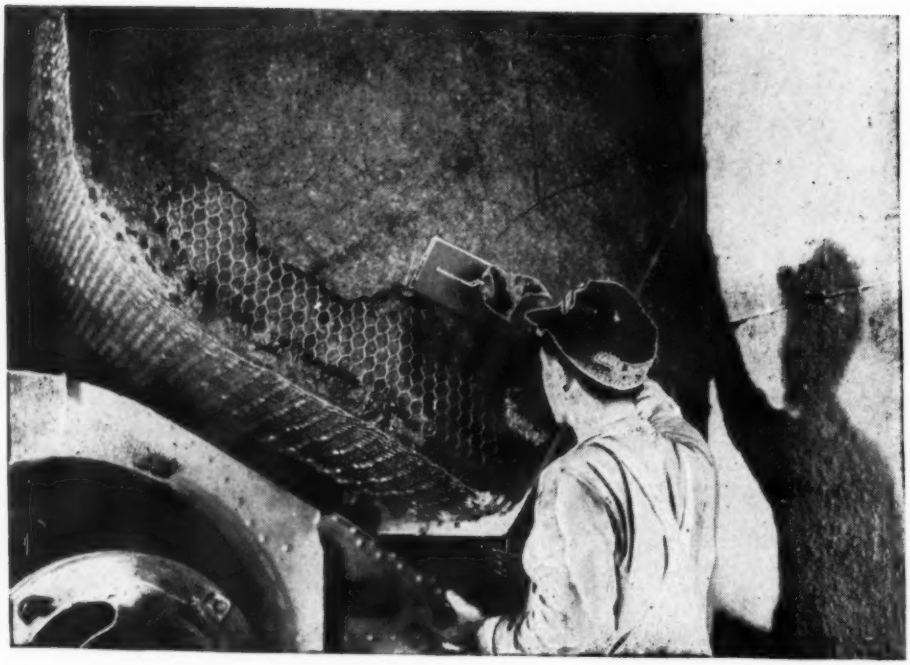
See Our Booth No. 568 at the Power Show in Grand Central Palace, New York, in December

FOUNDED 1905 **MEMBER OF A. G. M. A.**

Sier-Bath Gear Co. Inc.

PUMP DIVISION

SIER-BATH GEAR COMPANY, INC.
9254 HUDSON BOULEVARD • NORTH BERGEN, NEW JERSEY



Users applaud the high Rust-Inhibition of Eagle Super "66" Insulating Cement

Men who have used Eagle Super "66" Insulating Cement are enthusiastic not only about its great fuel-saving ability — they applaud the way Super "66" actually inhibits rust on heated metal equipment!

This unique rust-inhibitive quality has been conclusively proved by laboratory tests, and in actual use. It's an important factor in prolonging the life of boilers, ovens, tanks, towers, heat exchangers, etc.

"Springy Ball" structure gives remarkable efficiency

The tremendous insulating efficiency of Super "66" comes from its "Springy Ball" pellets of Eagle Mineral Wool. Each pellet is a maze of dead air cells — one of Nature's most effective barriers against passage of heat. "Springy Ball" structure is permanent — lasts as long as the insulation.

Eagle Super "66" withstands a full range of temperatures up to 1800° F. If not subjected to temperatures above 1200° F., it can be *removed, remixed* and *re-used!* An all-purpose insulation, it can be troweled with little effort on almost any size or shape surface. Wet coverage is as high as 65 sq. ft. per 100 lbs., 1 in. thick . . . and shrinkage is less than 15%.

Send for data sheets. *They contain complete technical information about Eagle Super "66". Available on request.*

Other Eagle Industrial Products include:

Eagle Insulseal. A protective coating for insulation. Trowels on — dries to a hard finish. Withstands temperatures up to 450° F.

Eagle Swetchek (black). A prepared, asphaltic base, rust-inhibitive anti-condensation compound.

Eagle "43" Finishing Cement. A hard white finish coating for all types of indoor insulation within a range from 70° F. to 800° F.

EAGLE-PICHER INSULATIONS
High and Low Temperature

EAGLE EP PICHER

THE EAGLE-PICHER COMPANY • CINCINNATI (1), OHIO

Eagle Super "66" Insulating Cement • Eagle L-T and M-2 Felt • Eagle Supertemp Block • Eagle Blankets • Eagle Pipe Covering
Eagle Insulseal • Eagle Loose Wool • Eagle Insulstic • Eagle Swetchek

Engineered and Proved Construction

1. FORGED STEEL CASE—Supported at the center-line to prevent distortion caused by changes in temperature—vertically split with ring type joints to assure tightness under all pressures and temperatures. May be lined with corrosion resistant material when necessary.

2. REMOVABLE END COVERS—Of forged steel.

3. DEEP WATER-COOLED STUFFING BOXES—With renewable throats—reduce wear and prolong life of packing.

4. PACIFIC PATENTED FLOATING SEAL—Hydraulically balanced—non-seizing—balances lateral thrust of rotating element and reduces pressure on discharge stuffing box to suction pressure.

5. DIFFUSERS—Efficiently convert velocity energy to pressure energy—assure perfect radial balance.

6. POSITIVE STAGE-TO-STAGE SEAL—Seals face-to-face and metal-to-metal—all interior gaskets eliminated.

7. PRESSURE LUBRICATION—Provided for all bearings by oil pump driven from pump shaft.

8. PACIFIC TYPE I CENTRIFUGAL PUMP—May be dismantled and re-assembled without breaking suction and discharge connections. The rotor may be completely assembled outside of pump shell.

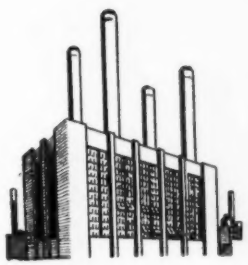
RATING—Designed for speeds up to 3600 R.P.M.

Sizes—2 to 8 inches.

Capacities—75 to 2700 G.P.M.

Differential Pressures—up to 2500 lbs.

Operating Temperatures—up to 800° F.

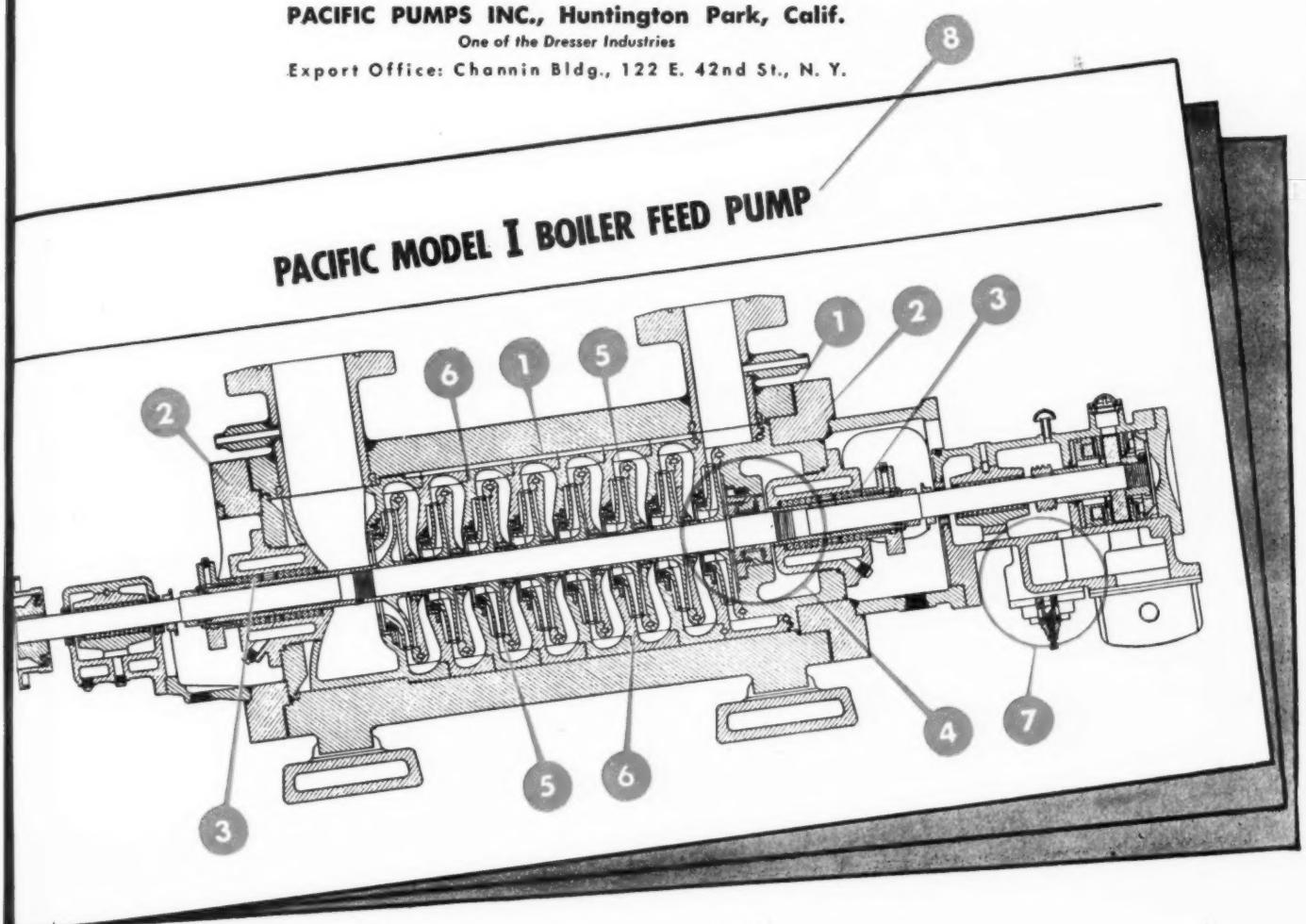


Write for Pacific Pumps Bulletin 80

PACIFIC PUMPS INC., Huntington Park, Calif.

One of the Dresser Industries

Export Office: Channin Bldg., 122 E. 42nd St., N. Y.



PACIFIC *Engineered* PUMPS

CROWN HER! . . .

Not just good but best—that's good Queen Bess! She's in a class by herself, an arrant specialist if there ever was one. Milk and milk alone is her line, and in her line good Queen Bess is a terrific perfectionist.

SPROCKET CHAINS . . .
and Sprocket Chains Alone Are Our Business

Just sprocket chains. Sprocket chains morning, noon and night. We're specialists—and even, we like to think, perfectionists. Do you see, then, why so many manufacturers, alive to the economical, efficient, trouble-free performance of sprocket chains for power transmission and materials handling, like to entrust the solution of their problems to specialists here at Union Chain?

The Union Chain and Manufacturing Company - Sandusky, Ohio

Union Finished Steel Roller Chain is manufactured in all standard sizes from ⅜ in. to 2½ in. pitch, in single and multiple strands.

UNION CHAINS

Union Chains for Every Application

Drive and Conveying Chains and Sprockets
- Bridge Chain
- Combination Malleable Iron and Steel Chain
- HB (hardened bearing) type chain
- BP (bar and pin) type chain

★

Finished Steel Roller Chains and Sprockets
- All manufacturer's standard, size ⅜ in. to 2½ in. pitch
- Single and Multiple Strands
- Extended Pitch Series in sizes 1¼ in. to 4 in. pitch

★

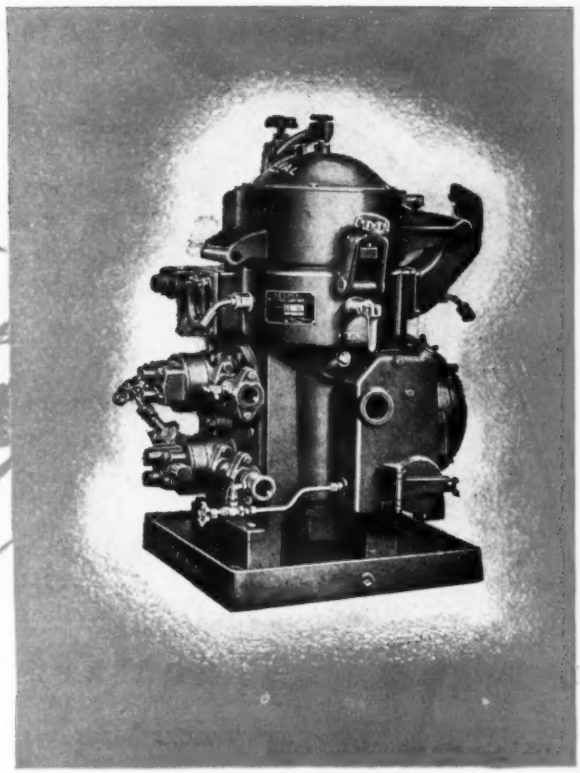
Silent Chain and Sprockets
- All sizes ⅜ in. to 1½ in. pitch

★

Flexible Couplings
- Roller chain type
- Silent chain type

GIVE YOUR TURBINE . . .

Complete Protection



PROTECT your turbine from ***both*** of the chief causes of lubrication failure—dirt and water. To rid the lubricating oil of dirt only is to give the turbine just ***half*** of the protection it requires.

A De Laval Oil Purifier provides a simple, effective means of insuring against the troubles caused by water and dirt. Its purifying action is instantaneous and wholly mechanical. Foreign material is thrown out by centrifugal force, and this centrifugal force removes from the oil and continuously discharges condensate or other water.

If a turbine protected by a De Laval Oil Purifier should develop a water leak, the excess of water would likewise be removed before damage could be done. There would be no sudden formation of "liver" in the lubrication system.

De Laval Oil Purifiers have another inherent advantage—they discharge the purified oil with oil-soluble additives intact.

- Write for Bulletin 400 for details.

DE LAVAL

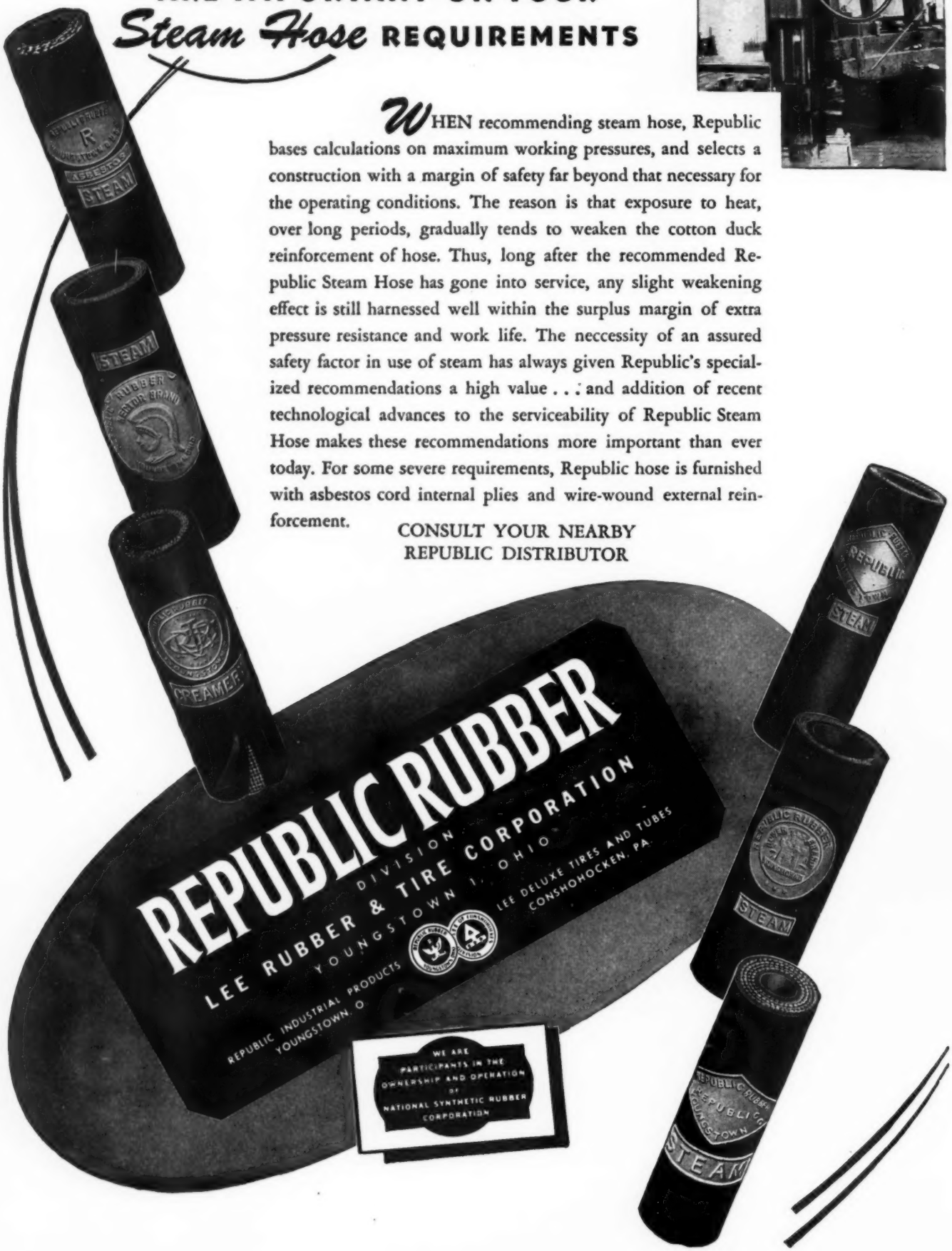
THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

LUBRICATING OIL PURIFIERS

WHY *Republic* RECOMMENDATIONS ARE IMPORTANT ON YOUR *Steam Hose* REQUIREMENTS

WHEN recommending steam hose, Republic bases calculations on maximum working pressures, and selects a construction with a margin of safety far beyond that necessary for the operating conditions. The reason is that exposure to heat, over long periods, gradually tends to weaken the cotton duck reinforcement of hose. Thus, long after the recommended Republic Steam Hose has gone into service, any slight weakening effect is still harnessed well within the surplus margin of extra pressure resistance and work life. The neccessity of an assured safety factor in use of steam has always given Republic's specialized recommendations a high value . . . and addition of recent technological advances to the serviceability of Republic Steam Hose makes these recommendations more important than ever today. For some severe requirements, Republic hose is furnished with asbestos cord internal plies and wire-wound external reinforcement.

CONSULT YOUR NEARBY
REPUBLIC DISTRIBUTOR



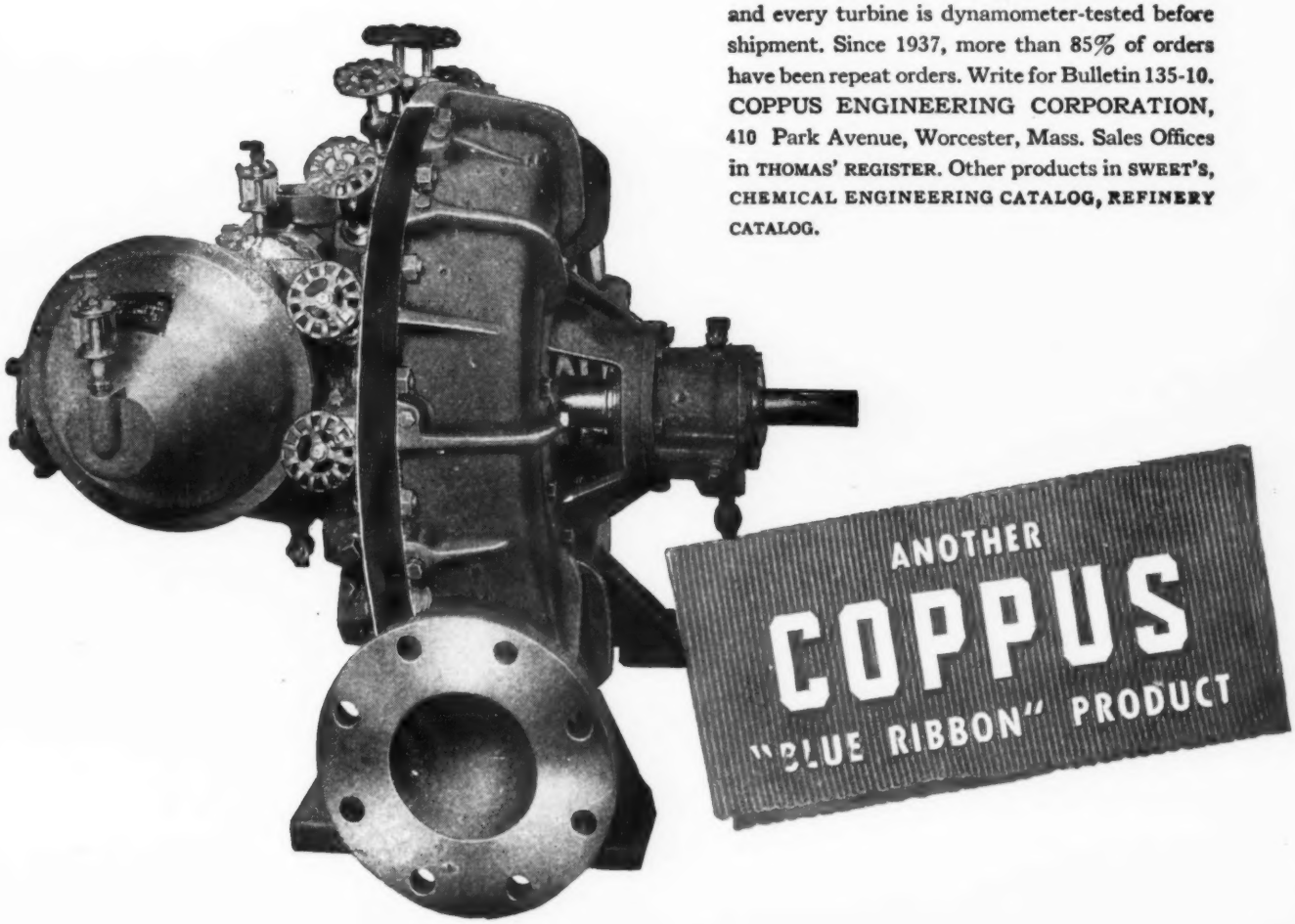
WHEN your equipment calls for small horsepower, you're saving money when a Coppus "Blue Ribbon" Steam Turbine is on the job.

Coppus makes turbines in six frame sizes from 150 HP down to fractional — so you can "fit" the power more closely to the need. No reason to pay extra for ordinary "elephant power" turbines, when you have a small horsepower requirement.

Many well-known manufacturers of original equipment have selected Coppus turbines. And they are to be found on U. S. destroyer escorts, driving vertical lubricating oil pumps . . . on U. S. Casablanca class aircraft carriers, driving main and auxiliary circulating pumps and fire pumps . . . on more than 90% of all Landing Ship Docks, driving condensate and clean ballast pumps.

A job for a Jeep, not a Truck

You, too, can rely on their dependable performance to meet your requirements for "jeep" power. Like all Coppus "Blue Ribbon" products (blowers, ventilators, gas burners, etc.), the Coppus turbine is a precision-made product — its accuracy controlled by Johansson size blocks — and every turbine is dynamometer-tested before shipment. Since 1937, more than 85% of orders have been repeat orders. Write for Bulletin 135-10. COPPUS ENGINEERING CORPORATION, 410 Park Avenue, Worcester, Mass. Sales Offices in THOMAS' REGISTER. Other products in SWEET'S, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.



With this remote control system, you are assured of on-the-spot accuracy and responsiveness up to 1000 feet away or *more*. In addition – temperature, pressure, flow or liquid level control can be centralized at a convenient point with complete absence of fire hazard or high pressure runs.

In this system of remote measurement and control, better-engineered Foxboro Instruments are used throughout. The complete system consists of a pilot-operated Transmitter to give positive power, and one or more Receivers connected by a single air line. This connection is made inexpensively with ¼" O.D. copper tubing.

The functioning of the Transmitter and Receiver is exactly matched for high accuracy. At the slightest change in measurement, the Transmitter changes the air pressure, and the pressure-calibrated element in the Receiver accurately measures the change.

If you are planning to improve the efficiency and safety factors of your plant through centralized control – investigate the important advantages offered by Foxboro Pneumatic Remote Measurement and Control. Write for Bulletin A 307-1, **The Foxboro Company, 68 Neponset Avenue, Foxboro, Mass., U. S. A.**

The interior construction of the Foxboro Receiver and Transmitter is illustrated in the diagram at the right. Both instruments are certified for accuracy and response. Certification is possible because the mechanisms employed have been proved successful by thousands of installations.

FOXBORO
REG. U. S. PAT. OFF.

PNEUMATIC TRANSMISSION
For Remote Measurement and Control

You'll be hearing more about

AXIAL FLOW

. . . AERODYNAMICALLY DESIGNED TO ASSURE EFFICIENCY

The airfoil section vanes placed immediately behind the adjustable pitch fan blades on La-Del Fans straighten out the flow of air and permit building up high pressures and a uniform, quiet, smooth air flow. Greater efficiency and economy results as air can be conveyed faster with less power in La-Del Axial Flow Designs.

Let us show you how La-Del Axial Flow Fans can help with your future ventilation problems.

Quiet Operation
Uniform Air Distribution
Peak Efficiency
No Turbulence

LA-DEL FANS
TROLLER DESIGNED

Write today for catalog on LA-DEL Axial Flow Fans

W&D 1505

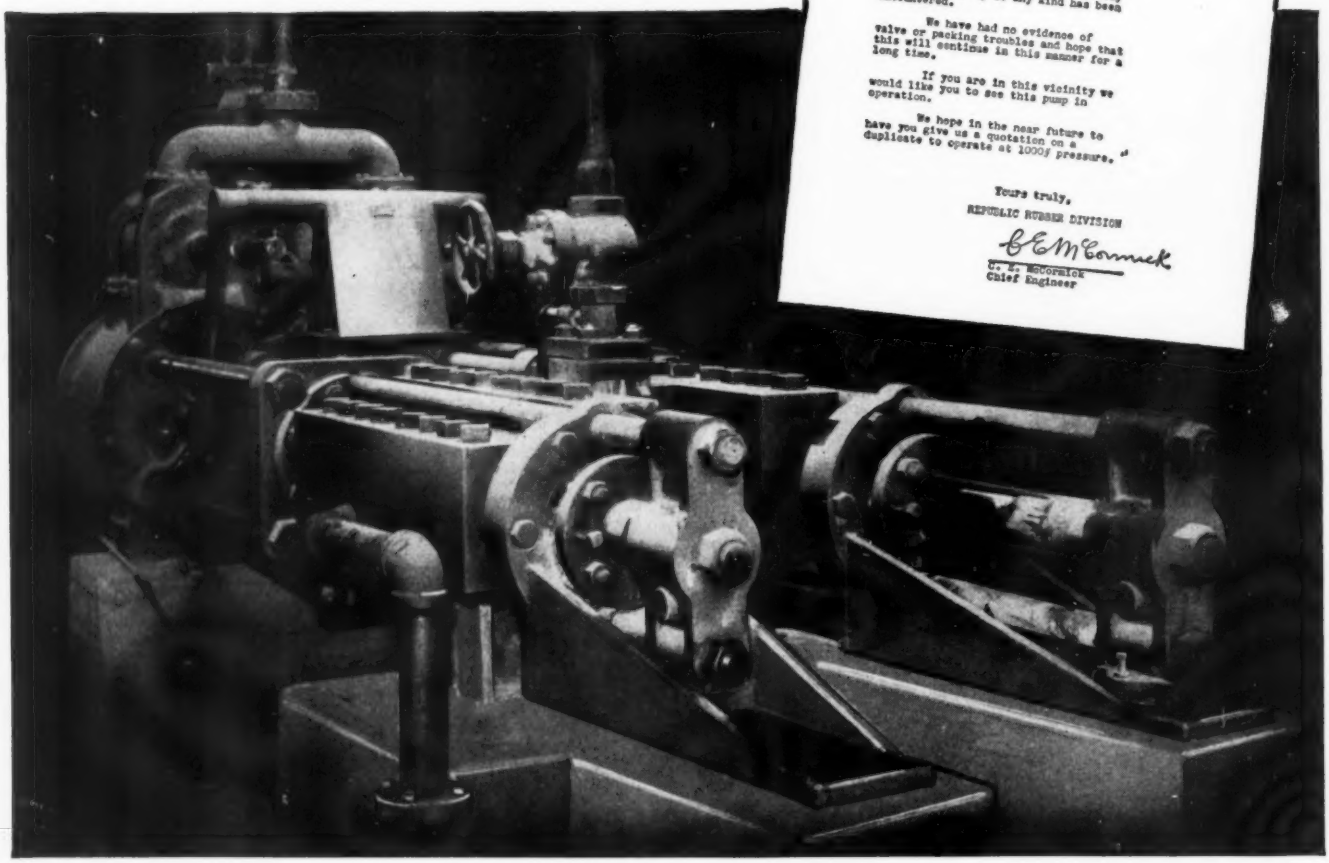
LA-DEL Division

JOY MANUFACTURING CO.

GENERAL OFFICES: HENRY W. OLIVER BUILDING, PITTSBURGH, PA.

"performs perfectly"

. . . writes Chief Engineer C. E. McCormick, of the Warren 2000 lb. Hydraulic Pump recently installed at the Republic Rubber Division, Lee Rubber and Tire Corporation.



Republic Rubber Division
LEE RUBBER AND TIRE CORPORATION
Youngstown 1, Ohio

April 19, 1946

Henry W. Kaiser Co.
1836 Euclid Ave.
Cleveland, Ohio

Gentlemen:

Subject: 2000# Warren Pump

The new pump has been operating now for a month and performs perfectly and no difficulty of any kind has been encountered.

We have had no evidence of valve or packing troubles and hope that this will continue in this manner for a long time.

If you are in this vicinity we would like you to see this pump in operation.

We hope in the near future to have you give us a quotation on a duplicate to operate at 1000# pressure.

Yours truly,
REPUBLIC RUBBER DIVISION
C. E. McCormick
Chief Engineer

WARREN DUPLEX 2000-LB. HYDRAULIC PRESSURE PUMP

PERFORMANCE, Stamina, Economy, and Dependability are qualities to check on when you select a hydraulic pressure reciprocating pump.

Warren Duplex Hydraulic Pressure Pumps have all those qualities, time tested . . . but that is not all. Smooth flow is assured because of liberal valve area. They give you long life because solid forged steel plunger barrels protect against breakage from shock and excessive pressure. There are no plug leaks because of Warren metal-to-metal joint—no gaskets. Adjustment for full capacity for each service is possible during operation due to outside adjustable valve gear.

Plungers, valves and valve seats of special stainless steel reduce wear and keep maintenance at a minimum. Write for Bulletin 238.

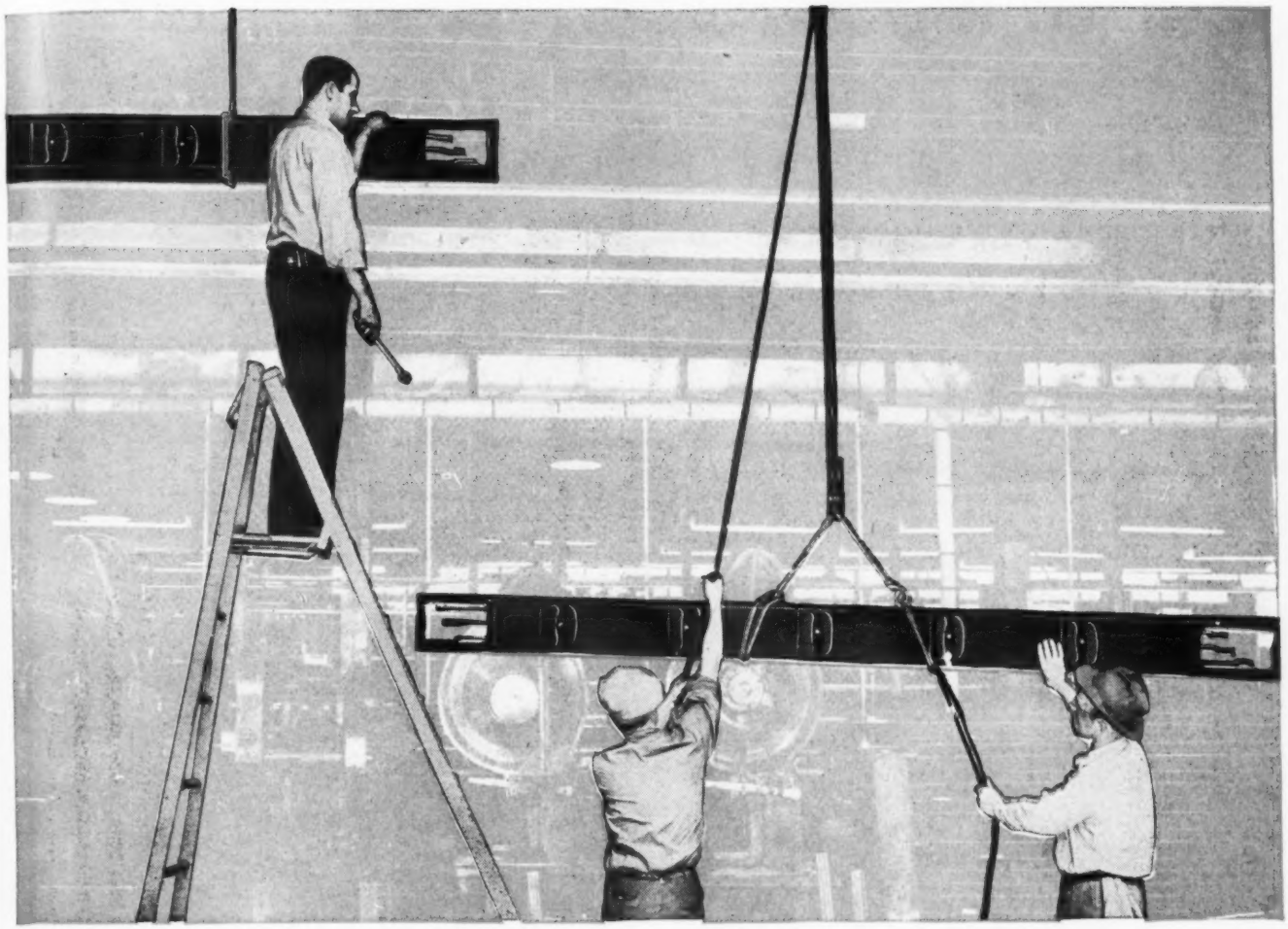
Warren Pumps

CENTRIFUGAL AND RECIPROCATING

P.7

WARREN STEAM PUMP COMPANY, INC., WARREN, MASSACHUSETTS

SPEED ELECTRICAL CHANGES WITH EASE...



You Can Do It With BullDog BUStribution DUCT

Move a machine . . . relocate a department . . . or revamp an entire factory layout. BUStribution DUCT, BullDog's modern, highly flexible electrical distribution system will meet every changing condition . . . with little or no rewiring.

Prefabricated, standardized BUStribution DUCT systems can be moved, altered and reinstalled with complete re-use of materials . . . they are 100% salvable.

Branch Circuits can be added wherever you need them because BUStribution DUCT and branch circuit fittings are designed for easy interconnection. Also, standard elbows, tees and crosses permit the system to fit any plan. Best of all, simplicity in design makes it possible to alter circuits with minimum demands for time and tools. Look at BUStribution DUCT from any angle and you see savings!

Electrical power systems are closely allied with machine tool layout. Therefore, production changes necessitate shifts in electrical power distribution. That's why it will pay you to investigate BullDog BUStribution DUCT and the advantages of "plug-in" power that is readily adaptable to changing production conditions. Write for details or call a BullDog field engineer. He can show you an installation near your own plant.

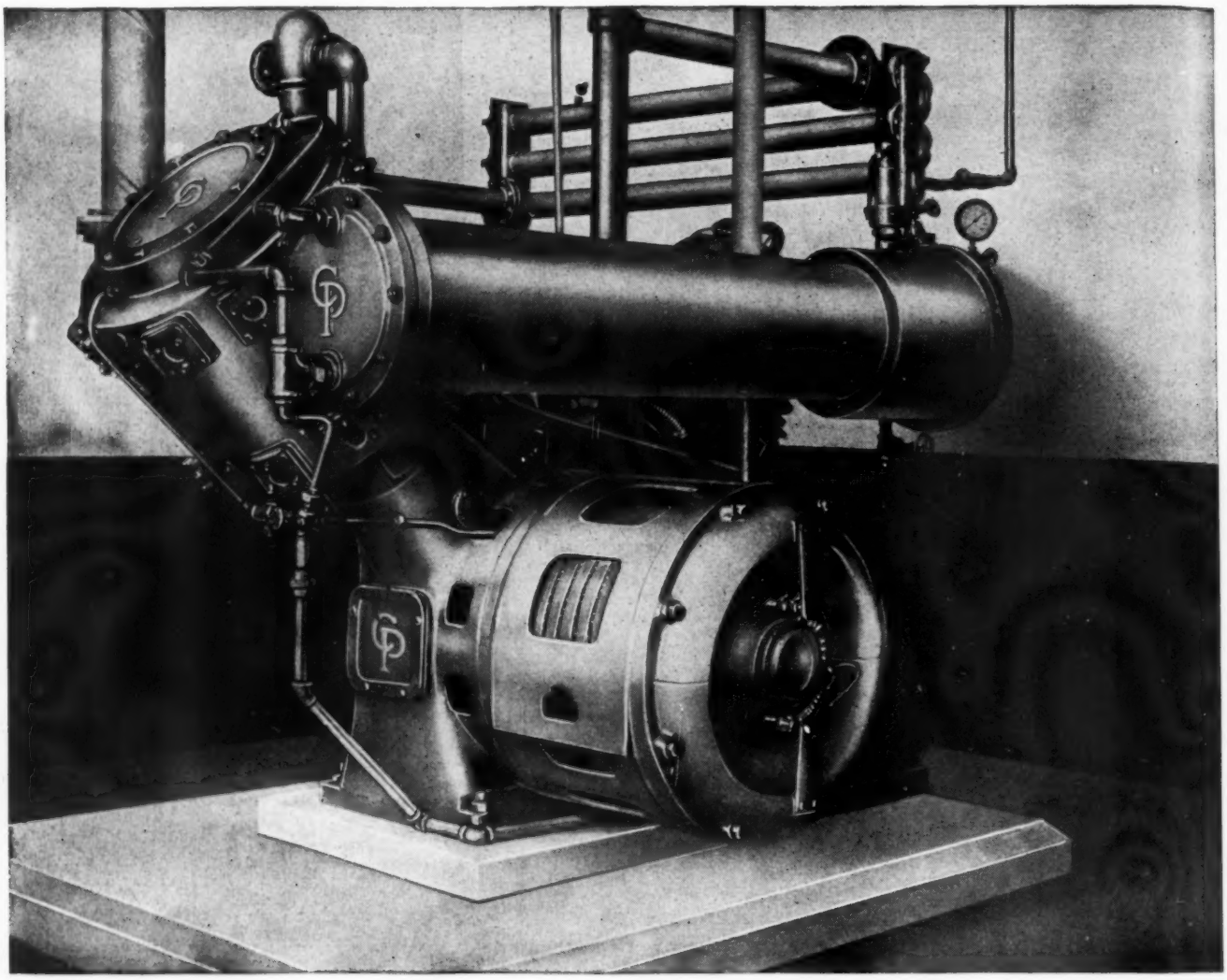
BullDog Also Manufactures Vacu-Break Safety Switches—SafToFuse Panelboards—Switchboards—Circuit Master Breakers—Industrial Trol-E-DUCT for Portable Tools, Cranes and Hoists—Universal Trol-E-DUCT for completely flexible lighting.

BULLDOG

ELECTRICAL DISTRIBUTION SYSTEMS

BULLDOG ELECTRIC PRODUCTS COMPANY, BOX 177, R. PK. ANNEX, DETROIT 32, MICHIGAN. In Canada: BullDog Electric Products, Ltd., Toronto. Field Engineering Offices In All Principal Cities

WHERE *Compactness* COUNTS!



CP TYPE Y COMPRESSOR IS IDEAL

ALTHOUGH designed for restricted floor space, the CP Type Y Compressor provides high efficiency and low maintenance. Shipped complete as a "package", ready for external connections, it requires only a simple foundation and no special skill in aligning or installing.

Large area Simplate valves, multi-step capacity regulation, effective intercooling, precision bearings, and force-feed lubrication assure its exceptional performance. With built-in or direct-coupled motor, or with V-belt drive, available in capacities of 500 to 900 c.f.m., at 80 to 125 pounds pressure. Sizes for other pressures also furnished. Write for information.

CHICAGO PNEUMATIC TOOL COMPANY

General Offices: 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

Thermoid – For Progress in Industry

The makers of the Beltloder have standardized on Thermoid belting for many years because it has proven itself capable of standing up under hard punishment. Exposure to weather, high angle of operation, intermittent loads, various kinds of materials all put the Beltloder and its Thermoid belting to an extreme test. The toughness and super-flexibility of Thermoid belting permits the use of a very small idler pulley on the Beltloder, making it possible to bring the belt closer to the ground and with less difficulty to push the conveyor into the pile of material to be moved.

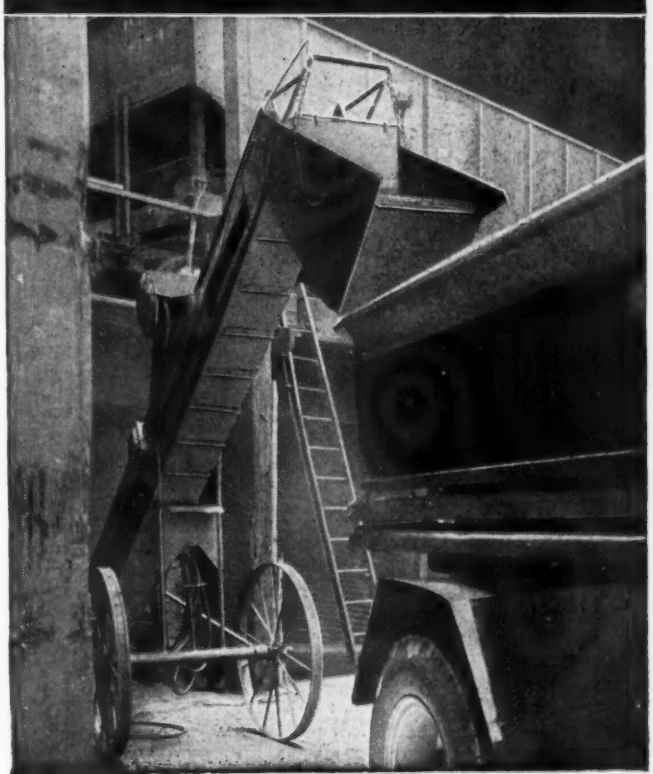
This is just one of hundreds of instances of the way Thermoid—working with designers, engineers and production men—has aided industrial progress. Whatever your problem in the field of materials handling or power transmission, you owe it to yourself to consult your Thermoid Representative. Like so many others, you may find—It's Good Business to Do Business with Thermoid."

THE THERMOID LINE INCLUDES: Transmission Belting • F.H.P. and Multiple V-Belts and Drives • Conveyor Belting • Elevator Belting • Wrapped and Molded Hose • Sheet Packings • Industrial Brake Linings and Friction Products • Molded Hard Rubber and Plastic Products.

Loading coal the costly, old-fashioned, back-breaking way.

★ ★ ★

Fast, economical coal-loading with the Thermoid-equipped Beltloder. On this rigorous job, users estimate that a single Thermoid conveyor belt handles as much as 100 thousand tons of coal.



Thermoid Rubber

DIVISION OF THERMOID COMPANY

308 Whitehead Road, Trenton 6, New Jersey

Contributor to Industrial Advancement Since 1880

There's Gold *IN STEEL SCRAP*

HERE IS THE WAY TO GET IT

Steel producers urgently need scrap.

Millions of tons of steel products that have served their usefulness are piled throughout the country. Cut it to charging box size and start it moving. Idle scrap means idle mills and idle fabricating plants.

Linde can supply the oxygen, acetylene, cutting equipment, and technical help for any scrapping operation.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

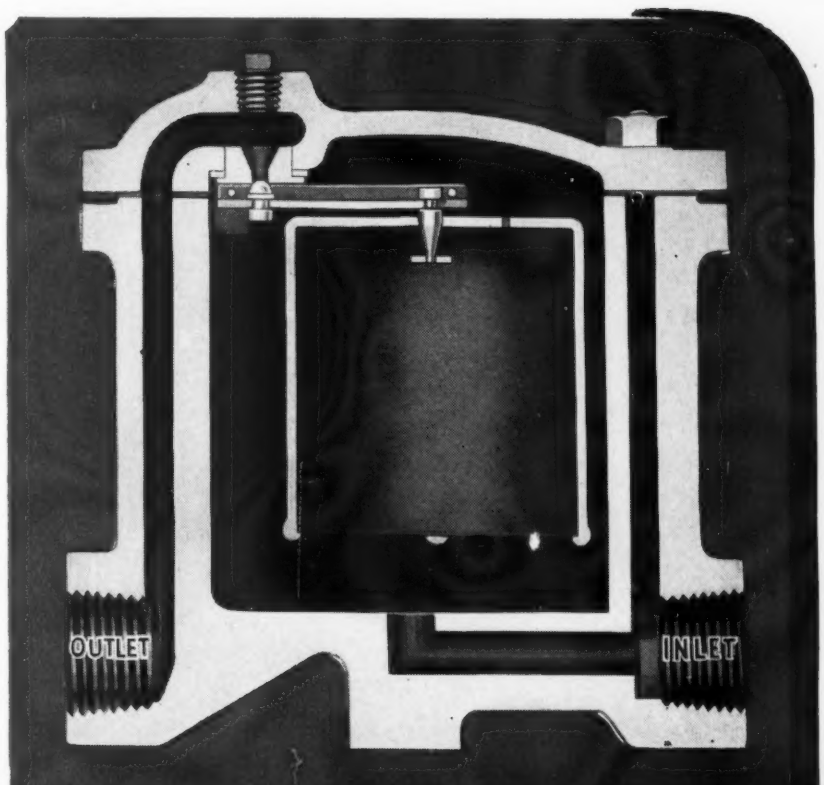
30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

LONGER LIFE . . .

Wherever steam, air or gas are used, Clark Fluid Controls not only give your equipment longer life, but they increase efficiency and decrease fuel costs.

38 YEARS of building better products have built a steadily rising acceptance for fluid controls made and backed by Clark.



The popular CLARK SERIES 70—small inverted bucket type steam trap with Clark Patented Bucket Venting Device and other exclusive Clark features, suitable for general drainage. Available in 3 sizes: ½", ¾" and 1". For pressures up to 200 P.S.I. and temperatures up to 400°F. Write for free catalog of complete specifications and applications for the wide line of Clark Fluid Controls.

Clark
FLUID CONTROLS

THE CLARK MANUFACTURING COMPANY • DEPT. A • CLEVELAND 14, OHIO

Makers of a wide line of fluid controls including

STEAM AND FLUID TRAPS	STRAINERS	PRESSURE REGULATORS
VACUUM AND LIFTING TRAPS	VALVES	REDUCING VALVES

INDUSTRIAL WATER CONDITIONING

FOR BOILER AND PROCESS

Chemistry + ENGINEERING *equal*

CORRECT WATER TREATMENT

Proper water treatment consists of something more than adding chemicals to a boiler system. All aspects of the problem must be considered, including Boiler Design, Operation, Application and Control, as well as the actual chemical treatment itself. There is no "cure-all" for water problems . . . Bird-Archer's 60 years of experience has established that fact.

Consultation without Obligation

THE BIRD-ARCHER COMPANY

NEW YORK 17, N. Y.
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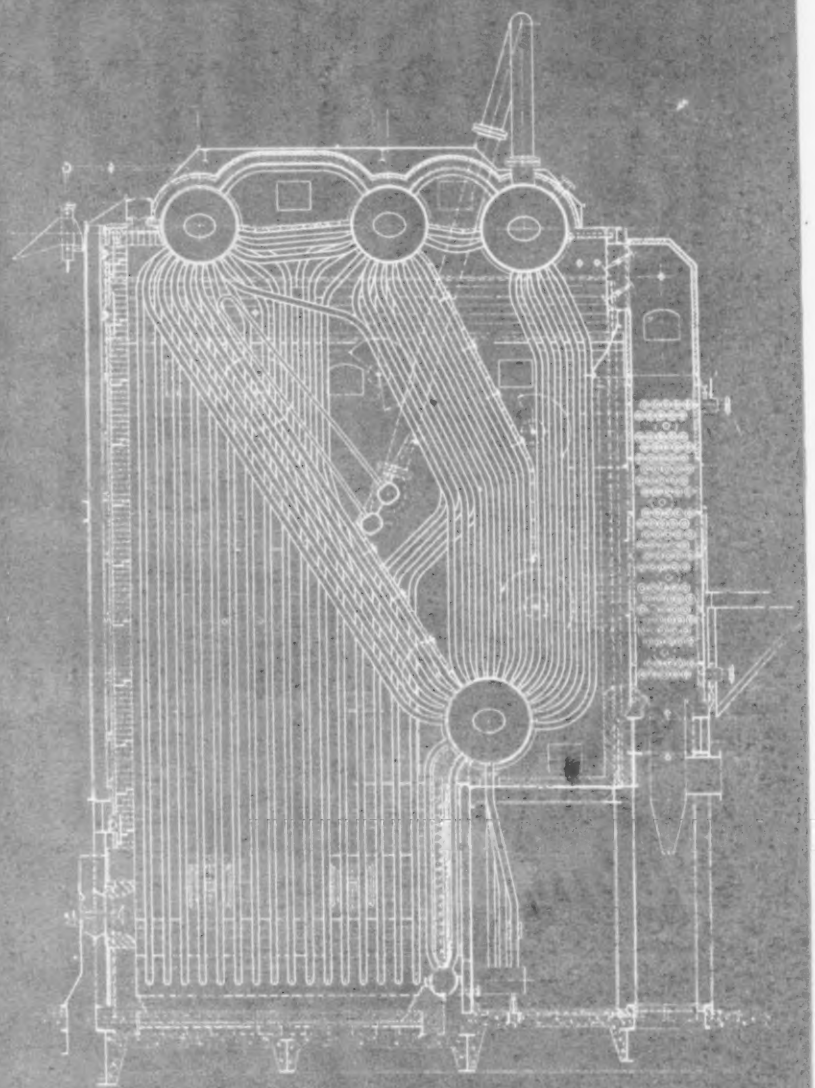
SURVEYS • PLANT STUDIES • SUPERVISORY SERVICE
PLANT DESIGN • TREATMENTS • LABORATORY SERVICE

WICKES 4-DRUM BOILERS

TIME TESTED AND POWER PROVEN

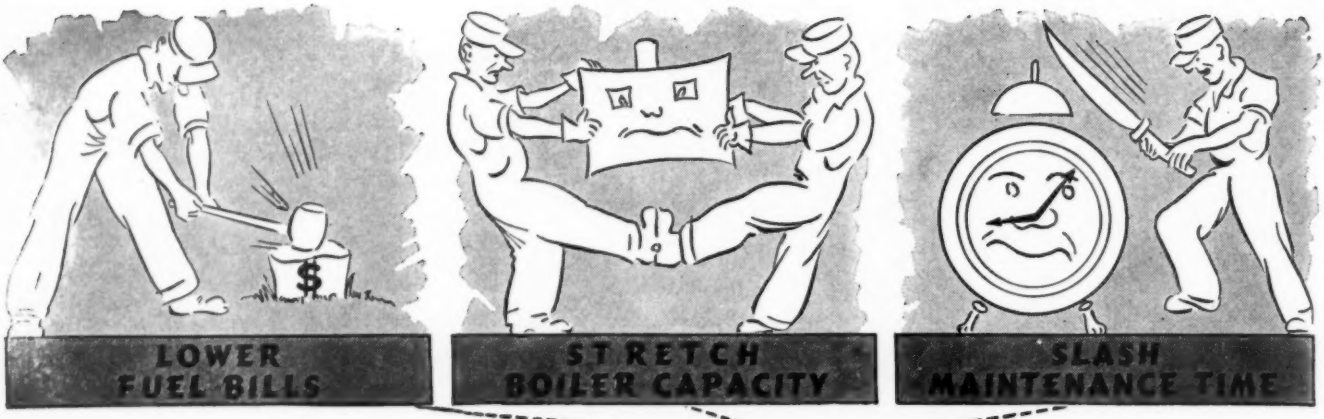


The unsurpassed dependability of Wickes 4-Drum Boilers is the result of careful workmanship applied to time-tested boiler design. As shown in the diagram, the three upper drums are installed nearly on a line and are connected by multiple circulating tubes to assure constant water levels at all ratings. Other readily apparent advantages are large diameter drums, minimum number of tube bends, and steam liberating area sufficiently large to insure rapid response to load changes. Tube arrangement and number may be modified to suit various stoker widths and other firing methods. Wickes 4-Drum Boilers are built for pressures up to 1,000 lbs. per hr., and capacities to 250,000 lbs. steam per hr. Our engineers will be glad to study your boiler requirements and show you how these or other Wickes boilers will increase power efficiency in your plant.

SALES OFFICES: Detroit; Chicago; New York; Milwaukee; Pittsburgh; San Jose; Tulsa; Fort Worth; Mexico City; Saginaw; Boston; Indianapolis; San Francisco; Buenos Aires; Seattle; Los Angeles; Atlanta; Charlotte; Denver; Jacksonville.

THE WICKES BOILER CO.

SAGINAW, MICHIGAN, U. S. A. • RECOGNIZED QUALITY SINCE 1854



GET THESE THREE RESULTS IN YOUR BOILER ROOM WITH···

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

TO achieve maximum boiler output with the least amount of fuel and attention, you must have Correct Fuel Feed — Proper Air Supply — Constant Over-Fire Draft.

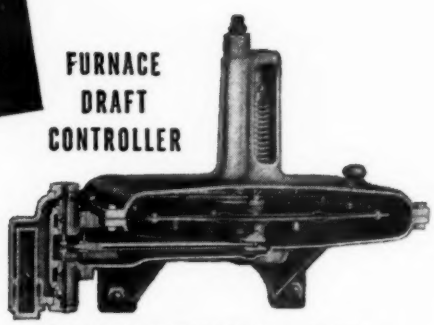
You accomplish this simply by installing a CASH STANDARD Automatic Combustion Control System. These units work as efficiently on multiple-boiler batteries as on single boilers.

CASH STANDARD Units can be combined to make a most accurate and dependable Automatic Combustion Control System to meet any condition and work on any boiler with any kind of fuel.

• Read about the application and operation of this system.

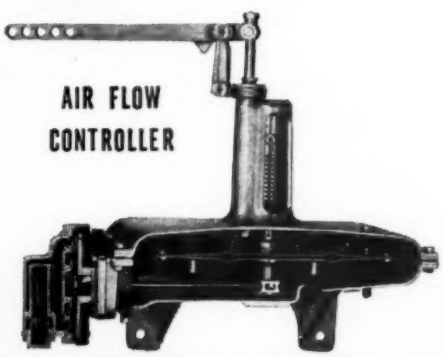
Write for a copy of our fully descriptive bulletin No. 300.

FURNACE DRAFT CONTROLLER

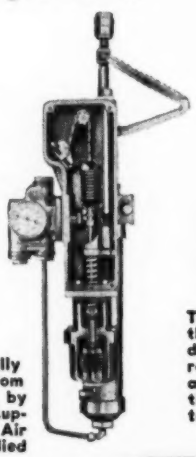


This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

AIR FLOW CONTROLLER



This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.

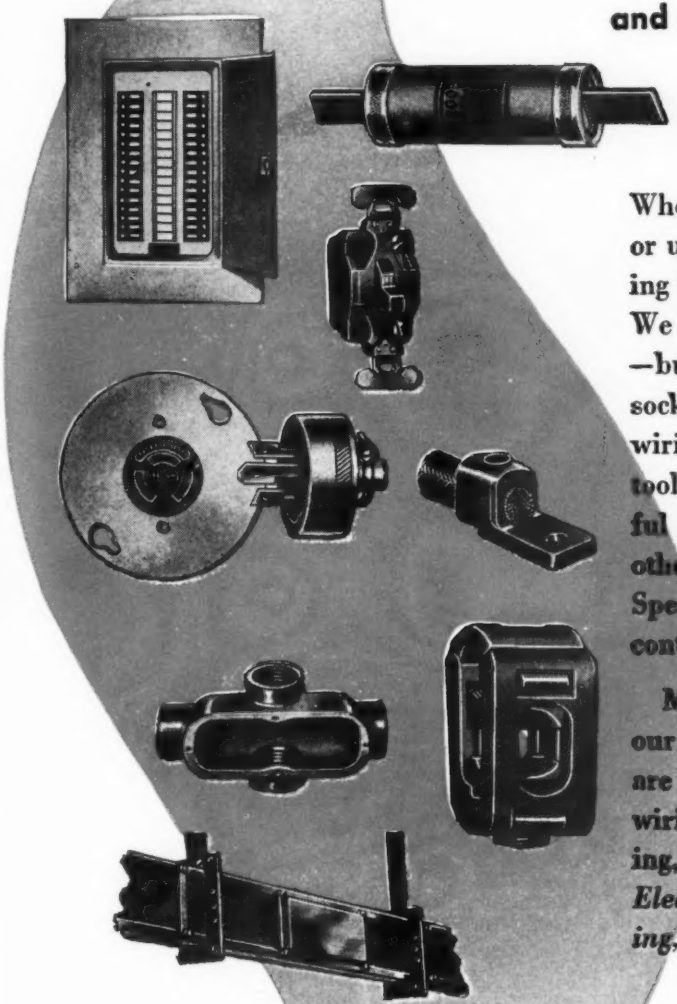
A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

EVERYTHING FOR . . .

Wiring your plant or product

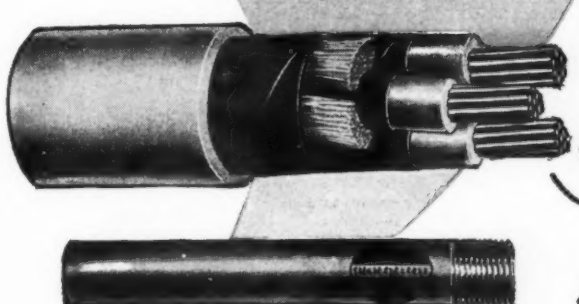
Graybar distributes wire, cable, wiring supplies and tools . . . offers specialized, local service



Whether the wiring will be indoors or outdoors—aerial or underground—there are excellent reasons for having Graybar provide *everything the job requires:* (1) We distribute carefully-selected makes of wire, cable—busduct, conduit, raceways—connectors, insulators, sockets—switches, panels, fuses—everything else for wiring, including primary equipment and specialized tools. (2) We *know* wiring—all kinds—and are careful to supply items that properly complement each other. (3) Right in your vicinity there's a Graybar Specialist who can capably assist you or your electrical contractor in planning any wiring job.

Many electrical items are quickly available from our near-by warehouse. As currently unavailable items are produced, we'll be ready to meet all your needs for wiring, power apparatus, ventilating equipment, lighting, electric tools, and communication units. *Graybar Electric Company. Executive offices: Graybar Building, New York 17, N. Y.* 4632

IN OVER 90 PRINCIPAL CITIES



Pre-fabrication brings to piping the benefits of factory methods and factory equipment. Pre-fabricated piping production is planned by men of long experience in the practical possibilities and limitations of piping. It is prepared in plants equipped with modern machinery and staffed by highly skilled organizations, including pressure welders whose work can be insured. This provides the exact control of procedure and the careful maintenance of quality that are characteristic of the best factory production.

Pre-fabricated piping is delivered to the job in a series of sub-assemblies ready to erect. All difficult operations have been performed . . . the sub-assemblies are commercially practical, correctly aligned, heat treated and stress relieved where necessary, thoroughly cleaned, shop tested and inspected. Piping pre-fabricated by a qualified fabricator is better piping . . . it saves money, time and trouble.

THE PIPE FABRICATION INSTITUTE

P.F.I.

Devoted to the Technical and Economic Problems in Piping

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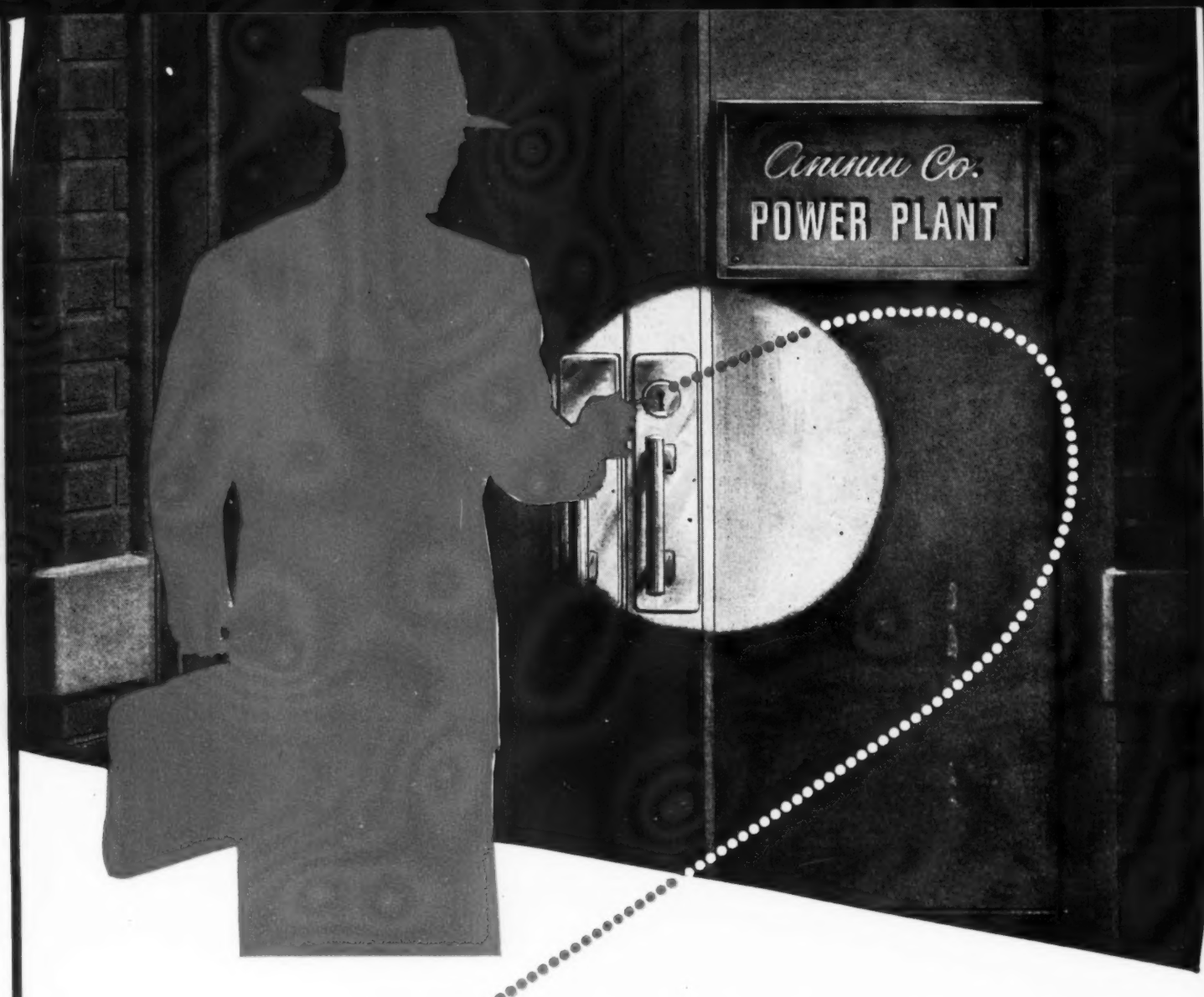

There's Only One Key

to the solution of your boiler water trouble

● Boiler water troubles, like locks, respond to one key . . . *and there is no master key* of one treatment for all waters.

The Dearborn Engineer has found, through the years, that proper boiler water analyses, linked with a specific chemical treatment, can unlock the most stubborn boiler water problem.

In the boiler room, he first takes steps to curb the immediate water trouble. Then he studies operating conditions and sends water samples to the laboratory.

● All of his findings are checked at Dearborn laboratories. Here the skill of experts in water analysis, interpretation and research is trained on your individual problem. The key to its solution is produced and transmitted to the Dearborn Engineer who calls on you . . . a corrective water treatment formulation, together with proper dosage instructions and application method.

Through the years this scientific individual service has proved its dependability and reliability.

Dearborn

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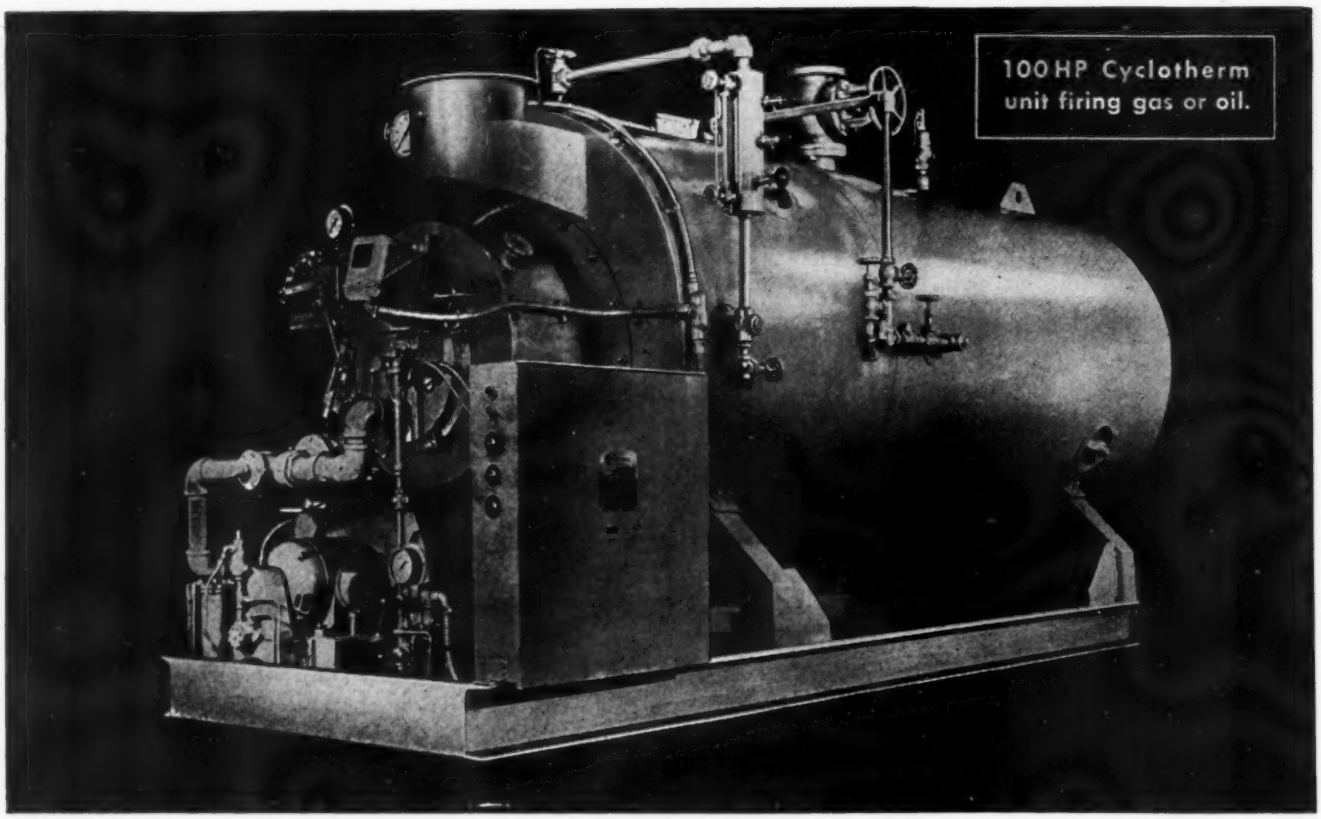
THE *LEADER* FOR OVER HALF A CENTURY

ENGINEERING SERVICE AND WATER TREATMENT

DEARBORN CHEMICAL COMPANY

Dept. D, 310 S. Michigan Ave., Chicago 4, Ill.

CYCLOTHERM ... the modern method of producing STEAM POWER



STEAM when you want it . . . at minimum cost . . .

Whatever your use of steam, there is a dependable Cyclotherm to do your job—and do it economically.

Initial cost and installation expense are low. Cyclotherm units are complete steam generating plants and are delivered to your door ready to operate on arrival.

Cyclotherm will minimize your operating and maintenance expense. The Cyclotherm exclusive method of combustion and heat transfer assures you of the highest operating efficiency. Simplified two-pass design makes maintenance problems easy. Larger sizes have hinged front assembly and rear door making tubes and furnace readily accessible.

Cyclotherm is manufactured in convenient sizes from 10 to 200 HP and with operating pressures from 15 to 200 psi. Units may be fired with any liquid or gaseous fuel and all operation is fully automatic. Heavy oil operation available in sizes 50 to 200 HP with automatic modulating controls. All sizes are also available with the Cyclotherm special combination burner arrangement to fire either oil or gas.

Wire, write or phone for more information

CYCLOTHERM STEAM GENERATORS

CYCLOTHERM CORPORATION, 90 BROAD STREET, BOX 302, NEW YORK 4, N. Y.

THEY TAKE THE TURNS *faster*

A powerful, streamlined motor drives the Lagonda cleaner, with its whirling cutter head, through the toughest scale and around difficult tube turns. It's a "scale-killer" under any scale conditions, on all tubes—straight or curved.

A special lubrication system provides a continuous flow of oil to all necessary parts of air-driven motors, including the front bearing, so that longer life and trouble-free operation are assured. Water-driven motors are water lubricated. Rugged, heat-treated crown cutters chew up every bit of scale on the first bite. And "trackless" cutter teeth are spaced unevenly so as to avoid striking the same point as they revolve inside the tube.

Get all the facts about Lagonda 1300 and 2000 series cleaners for boiler tubes now. Illustrated bulletins available on request.

ELLIOTT COMPANY
Lagonda Division, SPRINGFIELD, O.
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

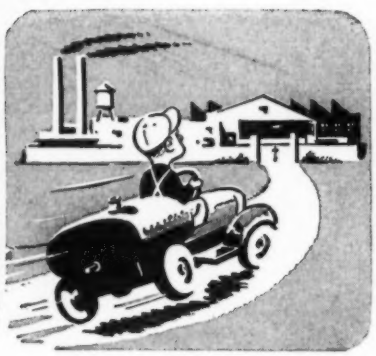
Lagonda
TUBE CLEANERS

7-288

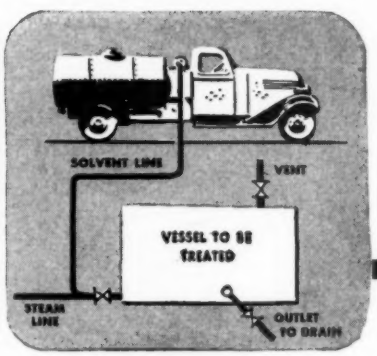
"NO MORE BLACK GANGS"

INDUSTRIAL SCALE REMOVAL NOW DONE THE SCIENTIFIC WAY

The modern ICI way removes scales and sludges by safe and successful application of chemical treatment. This service includes complete analysis to determine exact type of scale, and often requires both tests of its chemical solubility and X-Ray examination for identification of complex substances.

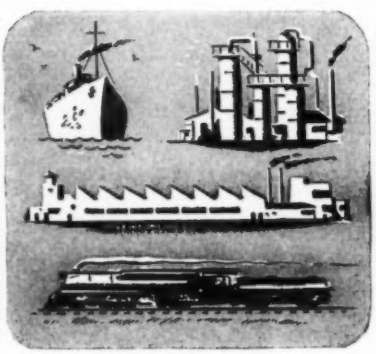


With the proper solvents determined, International equipment, manned by expert technicians, is available at any day and hour. This specially-designed equipment includes all required trucks, tanks, pumps, motors and fittings for immediate introduction of the right solvents into the unit to be cleaned.



A schematic diagram of a typical hook-up for the modern, economical, safe and time-saving method of removing water-deposited scales and sludges from all types of industrial equipment. The chemical solvents penetrate wherever water can flow, so that all interior surfaces are thoroughly cleaned.

Heat transfer units are quickly restored to original efficiency—excessive cost of manual cleaning is eliminated—no dismantling or disassembly is necessary and time off the line is reduced to a matter of hours. All this adds up to more profit for you.



It makes no difference what your industry may be, ICI methods and equipment are equally applicable to boilers, exchangers, water filters, condensers, blast furnaces, water tanks, water lines, economizers and the host of other products with the same characteristics.

Call ICI and watch your cleaning costs go down while your operation efficiency goes up. Remember, with ICI you have less down time; no disturbance; fuel costs are cut; all surfaces, including curved ones, small tubes and turns, are cleaned. Investigate this service now!

Licensed under processes practiced by Dowell, Incorporated, a subsidiary of the Dow Chemical Company.

CHEMICAL SERVICE DEPARTMENT, INTERNATIONAL CEMENTERS, INC.

LONG BEACH, CALIFORNIA

Service Offices:
Long Beach, Calif.—Tel. 48591 • Bakersfield, Calif.—Tel. 30255
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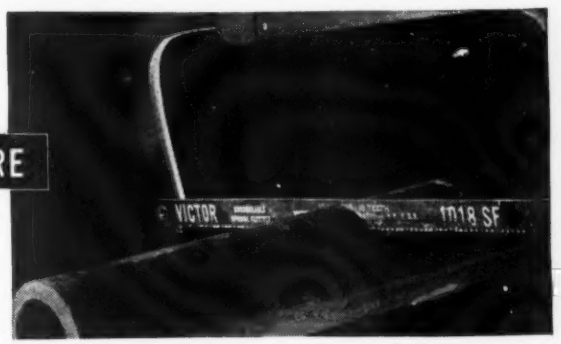
AVAILABLE NOW! Take advantage of this new 18-minute 35mm slide film with sound "More Power to America's Industry"—illustrating the possibilities of ICI's Chemical Scale Removal Service. Call or write your ICI man today.

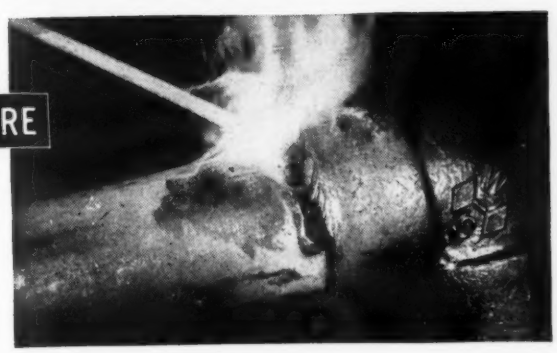
save with WATSON-STILLMAN drop forged steel fittings

WATSON-STILLMAN FORGED STEEL SOCKET WELD FITTINGS



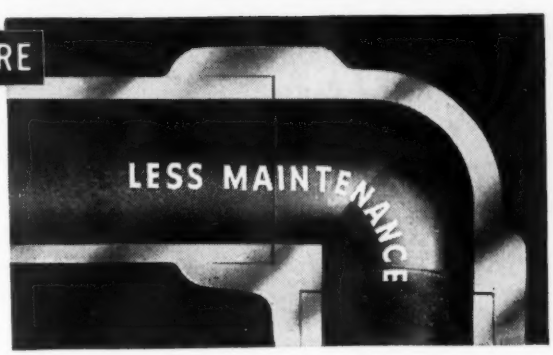
SAVE HERE

Watson-Stillman Socket Weld Fittings save measuring and cutting time. Pipe need not be cut to exact length or with square end, as deep sockets provide for ample come and go.



...AND HERE

The same deep sockets support and align the pipe—save welding time by eliminating tack welding and making the use of special fixtures unnecessary.



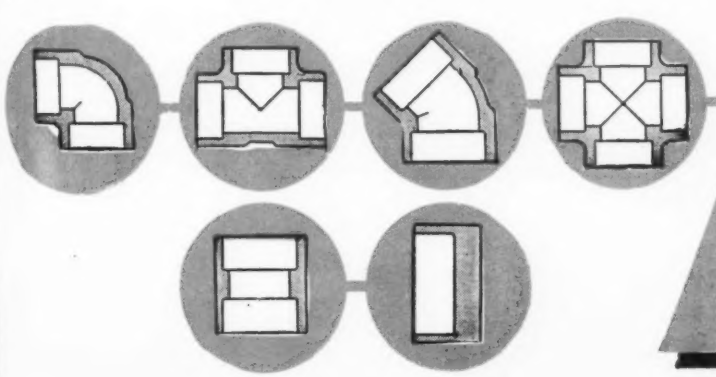
...AND HERE

Designed to take a properly proportioned fillet weld, W-S Socket Weld Fittings fuse with pipe into one integral unit, permanently tight and leak-proof, unaffected by vibration, distortion and shock. Position of weld prevents welding icicles inside pipe. Result: no clogged lines, maintenance and replacement costs cut to minimum.

FOUR CLASSES: For Schedule 40, Schedule 80, Schedule 160, and double Extra Strong Pipe.

ANALYSES: Carbon Steel, Carbon Molybdenum Steel, Chromium-Molybdenum Steel, and various types of Stainless Steel. Write for Bulletin A-3 Ed. 12. 1115

W-S Socket Weld Fittings Conform to proposed American Standards



WATSON-STILLMAN

DISTRIBUTOR PRODUCTS DIVISION

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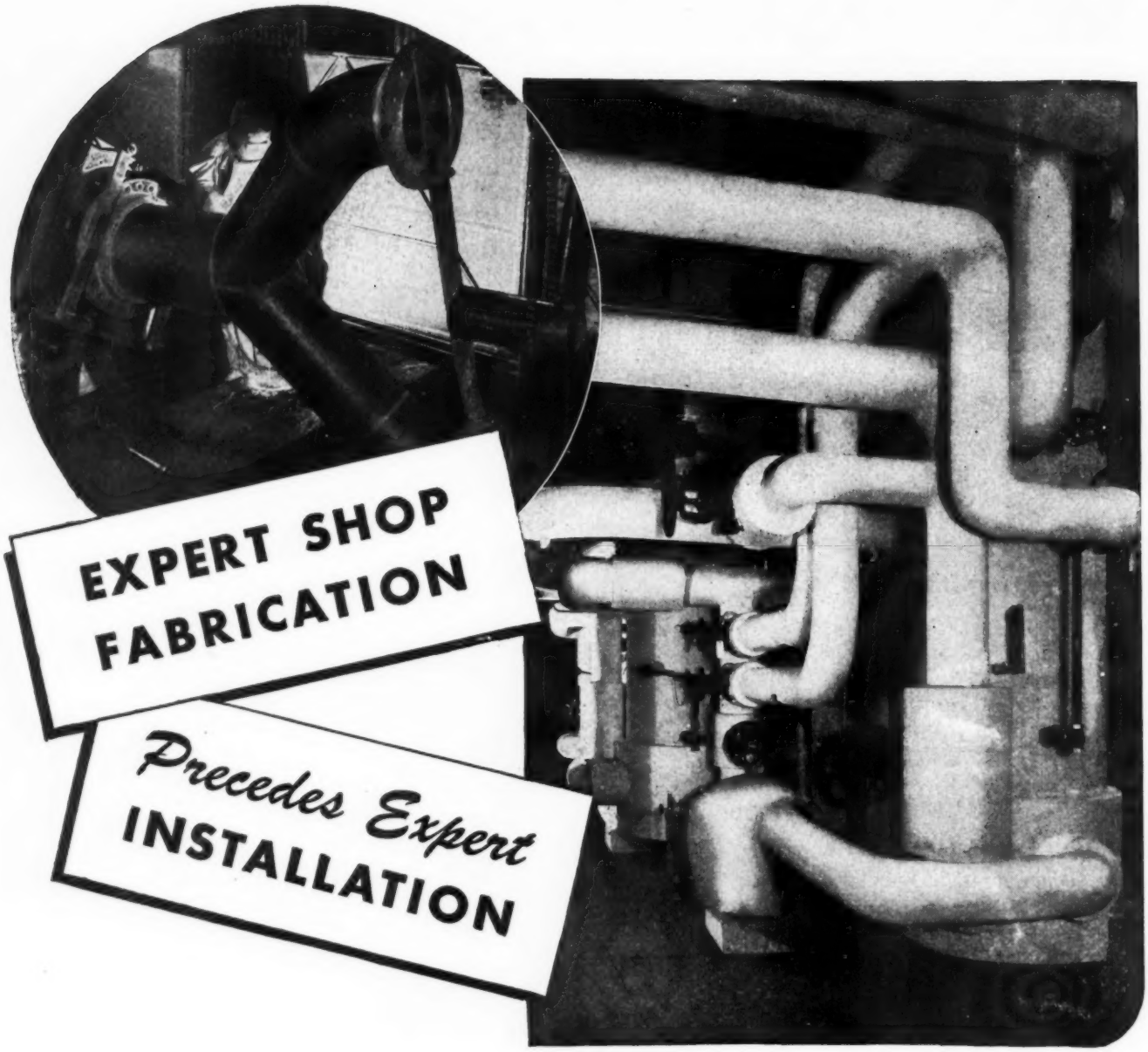

EXPERT shop fabrication of sub-assemblies – as large as shipping facilities permit – makes possible simpler, faster, cheaper erection. These sub-assemblies – produced under ideal conditions and with the aid of equipment not always available in the field – are stress relieved, pressure-tested, checked for dimensional alignment, cleaned and inspected, and are ready to slip into place.

Pre-fabrication is economical and efficient for power piping of every type and material. Our engineers will be glad to discuss with you its applicability to your particular problem.

Pittsburgh Piping
AND EQUIPMENT COMPANY
10 Forty-Third Street — Pittsburgh, Penna.

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Chamber of Commerce Bldg., Indianapolis
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Peoples Gas Building, Chicago
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10 High Street, Boston
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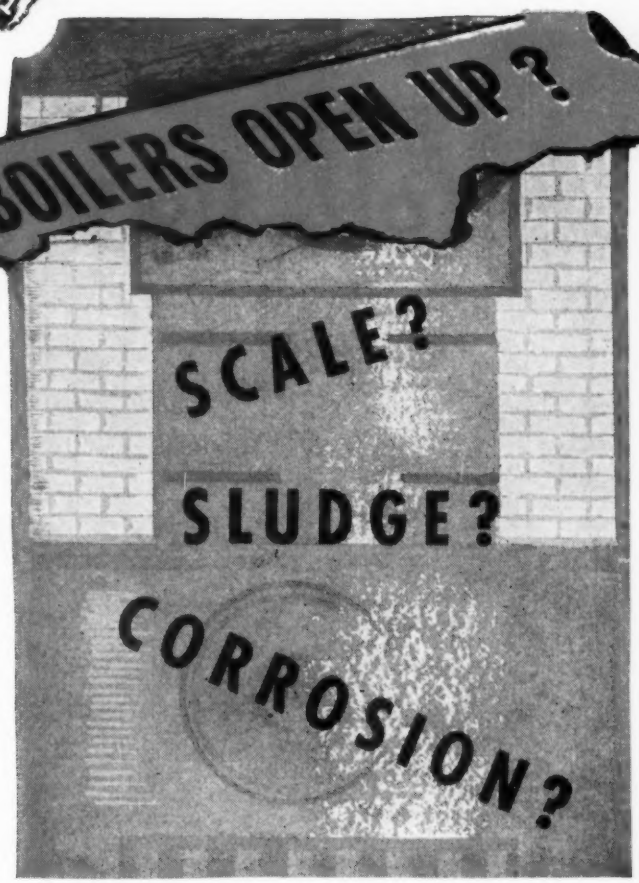
Whitehead Building, Atlanta

HOW WILL YOUR BOILERS OPEN UP?



Will you find...

NOT IF YOU'RE USING AMEROID

THE COMPLETE BOILER WATER TREATMENT

AMEROID

THE COMPLETE BOILER WATER TREATMENT

WHAT IS IT?

1. Sound chemical treatment. 2. A good organic coagulant. 3. Simple, scientific control. 4. Competent service and instruction.

WHAT WILL IT DO FOR YOU?

1. Prevent scale and corrosion. 2. Eliminate carry-over. 3. Regulate blowdown to save fuel. 4. Stop costly over-dosing, harmful under-treatment.

Engineers who use AMEROID Boiler Water Treatment know from day to day that their boilers are operating with maximum efficiency and economy. They are assured a clean bill of health at every boiler opening.

E. F. DREW & CO., INC.

15 EAST 26th STREET, NEW YORK 10, N. Y.

COMPLETE AMEROID SERVICE is available in key cities of the United States, Canada, Mexico, Brazil and Puerto Rico.

AMEROID

THE COMPLETE BOILER WATER TREATMENT

E. F. DREW & CO., INC.
15 East 26th Street. New York 10, N. Y.

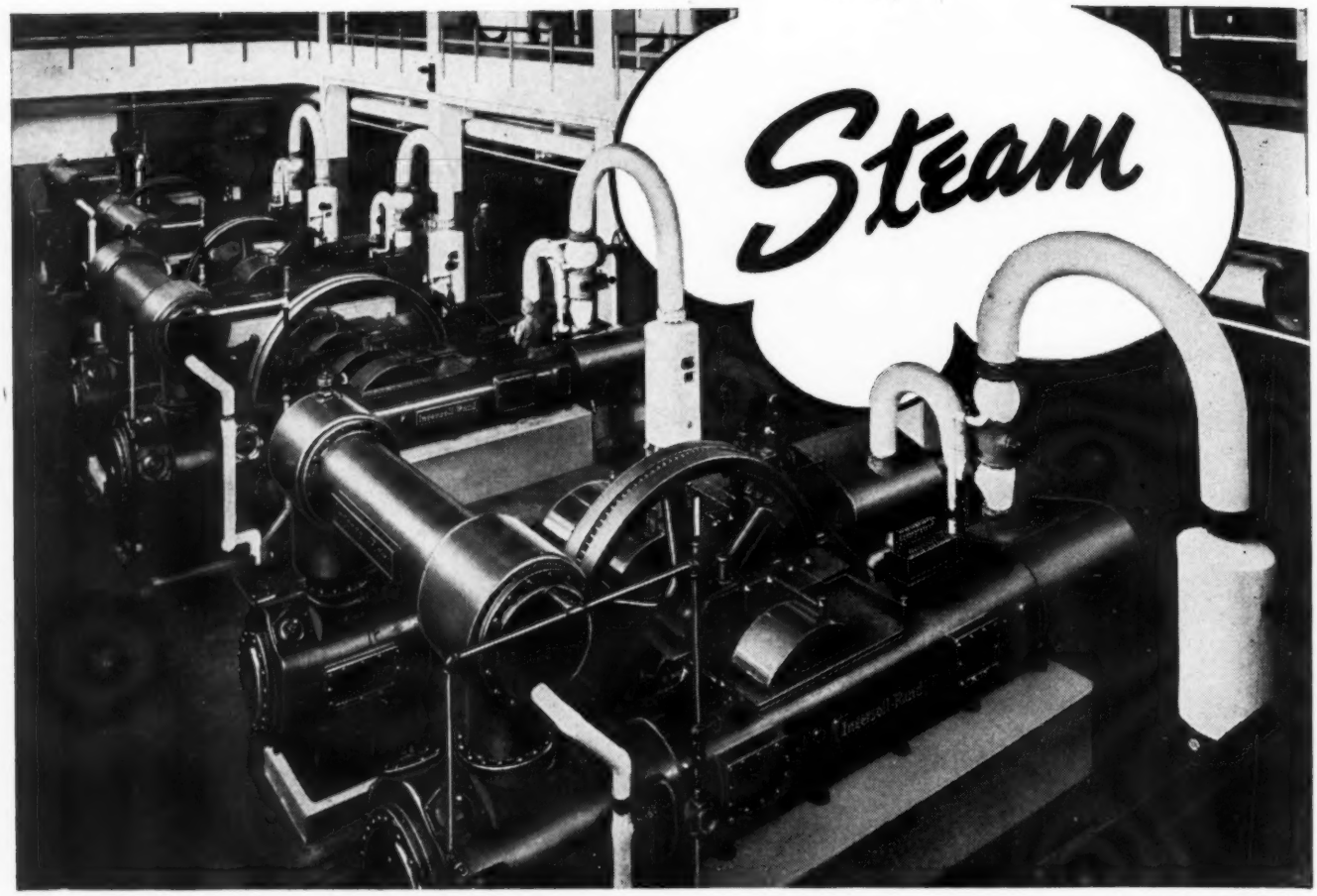
I am interested in further information about AMEROID, the Complete Boiler Water Treatment.

NAME .....

FIRM .....

ADDRESS .....

MAIL THIS COUPON TODAY!



Four Type XPV steam-driven and one XRE electric-driven compressors generating Air Power . . . total free-air capacity nearly 13,000 cfm. Steam exhausting at 30 psi is used for heating applications in the factory and boiler house. (*Photo, courtesy of Albert Kahn, Associated Architects and Engineers, Inc.*)

Generating AIR POWER

Air Power enables workers to do many jobs that can be done in no other way, and to do other jobs faster, cheaper, or better than by any other method.

When steam is available for generating Air Power, choose an Ingersoll-Rand Type XPV-compressor. Its horizontal, 4-corner construction, with steam and air cylinders at opposite ends, provides the greatest possible accessibility to all parts. Its governor holds the speed just fast enough to maintain the air pressure, regardless of steam-pressure fluctuations. Its durable and silent-operating Channel Valves make the air cylinders perform more efficiently.

And there are many other reasons for installing an XPV...built in sizes from 50 to 1500 hp for condensing or non-condensing operation with steam conditions up to 450 psi and 750°F.

Whether you are planning a new compressor installation, or improvements in your present Air-Power plant, an Ingersoll-Rand engineer can help you.

SEVENTY-FIFTH ANNIVERSARY

COMPRESSORS
CENTRIFUGAL PUMPS
OIL & GAS ENGINES
TURBO BLOWERS
CONDENSERS
AIR TOOLS
ROCK DRILLS

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 1-774

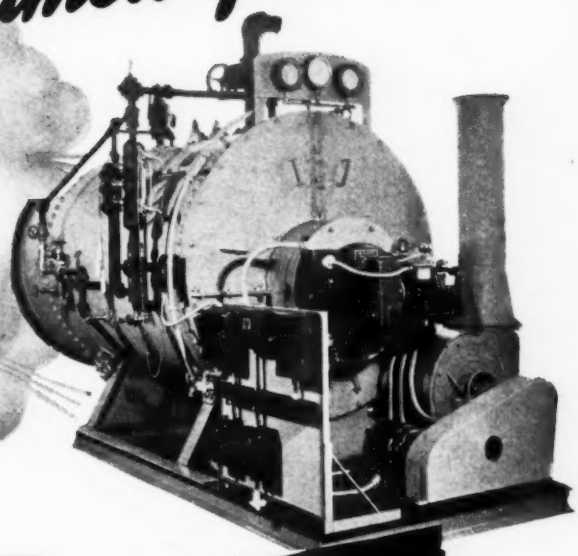
Worth Getting "Steamed up About"?

YES!

A PREFERRED

Unit Steam Generator

Means POWERful Profit To You!



Here is how the modern design, engineering and construction values of the Preferred Unit Steam Generator result in improved power plant operation . . . reduced steam costs . . . *increased profit.*

Pull-through draft—There is no stack to build . . . just a vent to outside air. Furthermore, an induced draft fan, which controls air volume, provides the exact amount of air needed without the danger of combustion products being forced into the boiler room.

Full Automatic Operation—Preferred Unit Steam Generators are equipped to burn light oil up to 100 B.H.P. and heavy fuel oil up to 500 B.H.P. fully automatically. When burning heavy oil the unit can be equipped with high-low operating mechanism.

Cuts Refractory Maintenance—The burner design and twenty-five years of oil-burning experience minimize refractory maintenance and prevent coking when bunker oils are used—even at low temperature.

Full Range of Sizes—The Preferred Unit Steam Generator is available in all sizes up to 500 B.P.H., either low pressure or pressures to 200 lbs.

Self-contained . . . portable . . . complete with all essential elements . . . the Preferred Unit Steam Generator operates at 80% thermal efficiency — or better — and reduces steam costs by as much as 25%. If your production budget is cut fine, this savings can mean a profit increase up to 40%.

Efficient power generation is basic to overall business efficiency. That's why a Preferred Unit Generator is really worth "getting steamed up about."

PREFERRED UTILITIES MANUFACTURING CORPORATION

1860 Broadway, New York 23, N. Y.

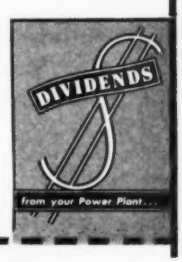
PR-124

PREFERRED UTILITIES

"DIVIDENDS FROM YOUR POWER PLANT"

You can help management to understand your responsibilities . . . and to realize the profit generating features of efficient power plant operation. Show them this new, informative booklet in which the problems of power generation are fully discussed . . . and authoritatively answered. It contains ten concise articles which are written in clear, simple terms so that non-technical executives can quickly grasp their import. "The Engineer is a Gold Mine" is one of the leading articles . . . and the entire booklet may prove to be quite a "gold mine" for you.

As soon as you return this coupon we'll send out your copy of "Dividends From Your Power Plant," together with our bulletin #1000.



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PREFERRED UTILITIES MFG. CORP.
1860 Broadway, New York 23, New York

Please send me FREE and without obligation, bulletin #1000 and the ten articles in booklet form, titled—"Dividends From Your Power Plant."

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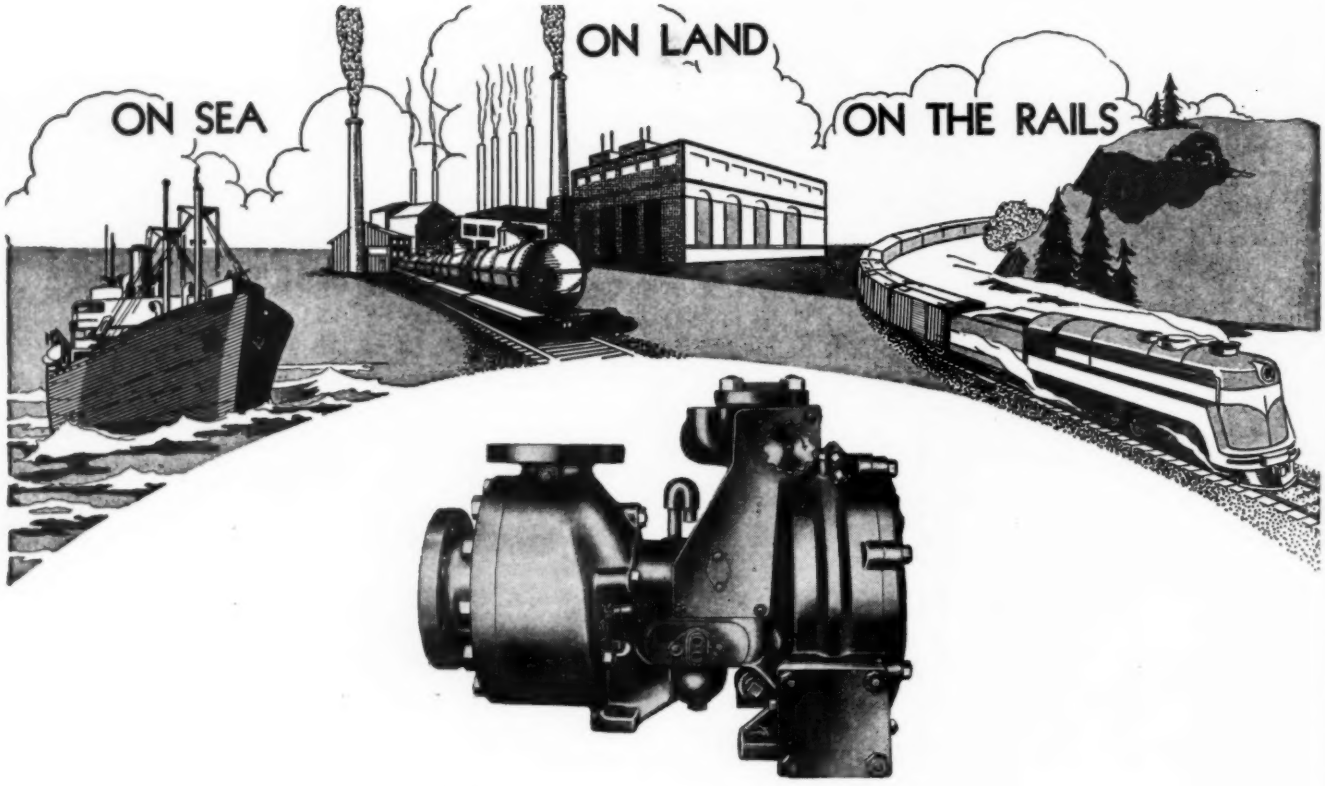

COFFIN—*Steam Turbine* CENTRIFUGAL PUMPS

Feed The Nation's Boilers

As its name implies, the Coffin Steam Turbine Centrifugal Pump is a combination of both centrifugal pump and steam turbine.

These elements are mounted on a common shaft. This eliminates alignment difficulties and saves space and weight.

Since both elements are designed and selected to function as a single unit, high efficiency and low steam consumption are achieved.

All wearing parts are made to precision gauge tolerances and one hundred per cent interchangeability is maintained. This insures a long, economical service life.

These pumps are available for capacities up to 500 G.P.M. and pressures up to 750 P.S.I.

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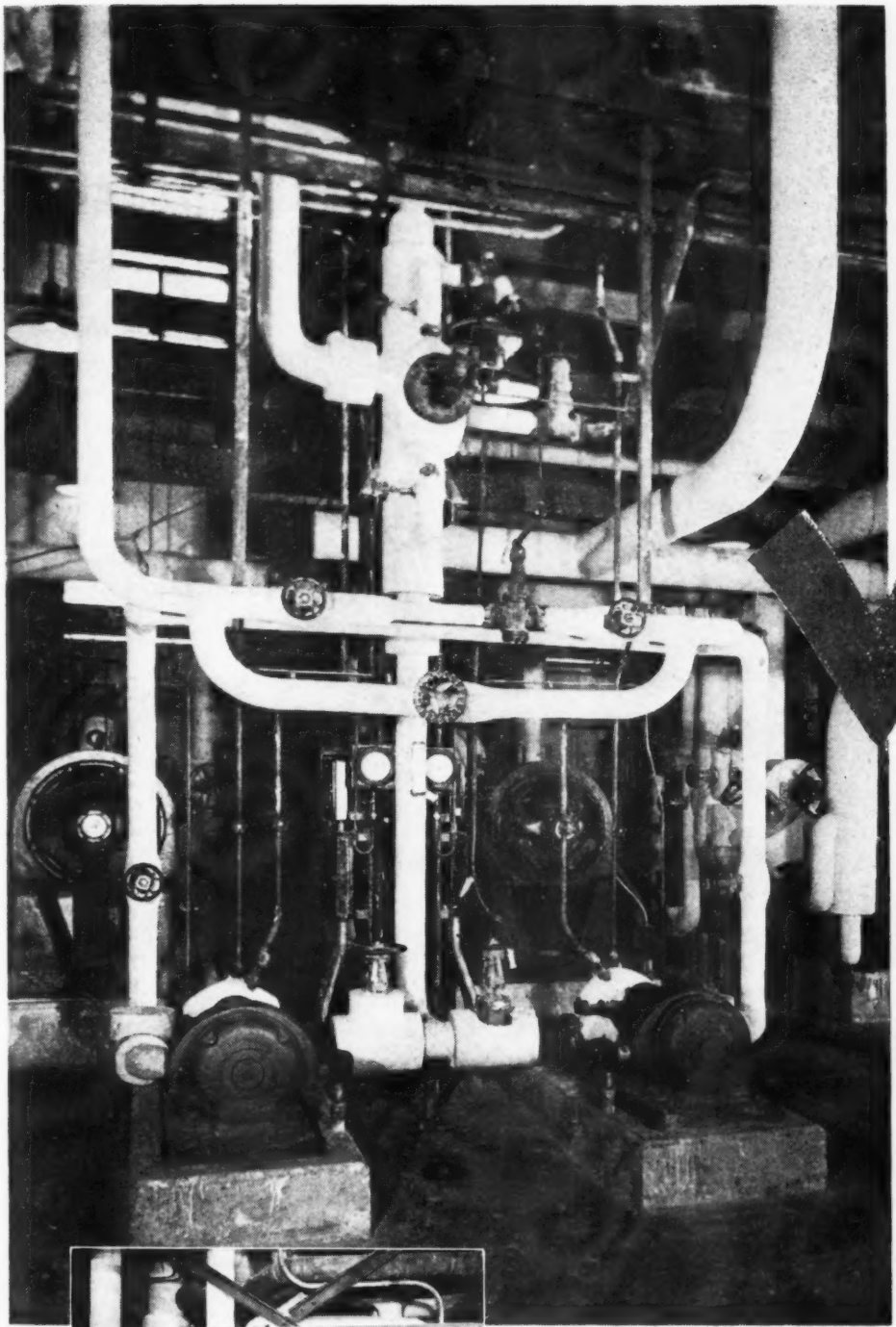

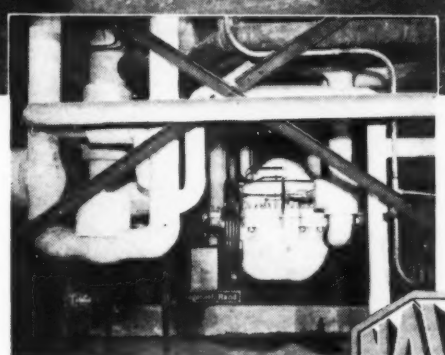

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The measure of any piping system, after the proper design has been reached, is the "fit". The knowledge which we have gained in the past 40 years is your guarantee of an accurate and workmanlike piping system. Navco quality in workmanship and design is evidenced by the many successfully operating installations which we have made for every industry. Consult Navco for your next piping job.

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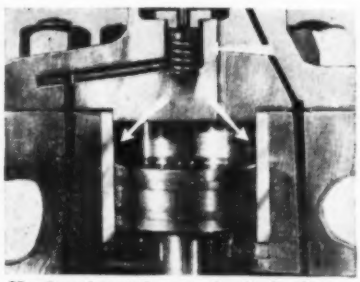
Exclusive LESLIE Features

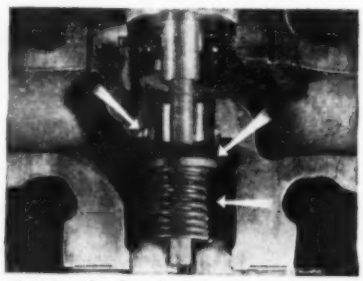
"... and, no other Regulators give you these Features as Standard Equipment!"

JIM — *Leslie Representative*
STAN — *Young Engineer*
TOM — *Plant Supervisor*

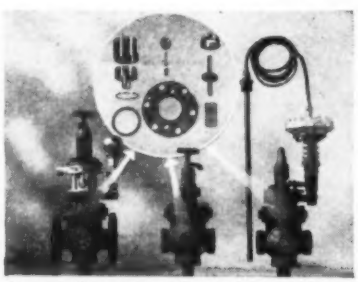
Characters and scenes from new LESLIE sound slide film titled, "Automatic Pressure and Temperature Control."



Hardened stainless steel cylinder liners—perfect main valve upper guides—retain proper alignment of valve, minimize wear.



Positive dead-end shut-off, no erosion or wire drawing. Precision-ground, hardened stainless steel valves, seat rings of stellite—corrosion resistant springs.



Internal parts are interchangeable in all regulators of the same size whether Reducing Valves, Pump Governors or Temperature Regulators.

Stan: "What features are those?"

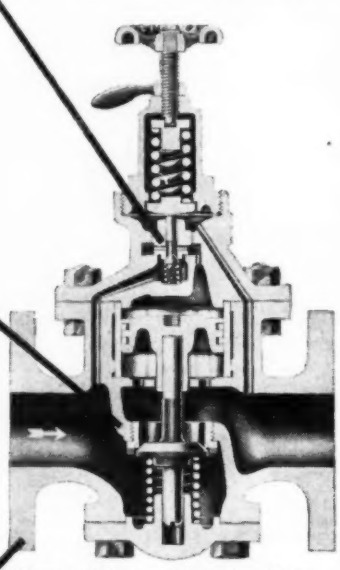
Tom: "Stellited Seat Rings—Stainless Steel 800 Brinell Main Valves—Hardened Stainless Steel Cylinder Liners—Corrosion Resistant Springs—Complete Interchangeability of Internal Parts Throughout all Self-Contained Regulators."

Stan: "For all types of service?"

Tom: "Regardless of the type of service—Steam, Air, Gas, or Liquid, as long as you require Pressure Reducing Valves, Pump Governors, Pressure Controllers or Temperature Regulators, you are assured of longer lasting, more accurate, trouble-free valves when you specify LESLIE."

Stan: "Why is that?"

Jim: "Because each valve is constructed of the highest quality material obtainable for the particular job it is designed to perform—each valve is precision-built to give you accuracy of regulation comparable to instrument control. And, each valve gives you these Exclusive LESLIE Features as *Standard Equipment*—at no extra cost."



Class L-3 Pressure Reducing Valve.

Write for
New Illustrated Bulletin 461
describing
LESLIE Pressure Reducing Valves

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255 GRANT AVENUE, LYNDHURST, N. J.

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- An outer wall of heat, flame and moisture resistant impregnated felted asbestos that won't dry out, crack, flow, rot or burn.
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THIS NEW SAFETY VALVE SAVES MONEY ON EVERY POP!

The Foster Type 38-SV Super-Jet Safety Valve for pressures up to 3000 pounds and temperatures up to 1000° F.

Because it reseats as close as 1% below popping pressure, the Foster 38-SV Super-Jet Safety Valve saves steam—saves *money*—on every pop. This new valve blows off only enough steam for safety . . . then reseats positively, without pounding or chatter.

But steam economy is only one advantage of this new safety valve. It is virtually unaffected by changes in temperature—once set under operating conditions, its popping point is constant. It gives full rated nozzle capacity at popping pressure—with negligible accumulation. Full opening is practically instantaneous—reseating is positive, without flutter or rebound even after sustained or successive lifts. And blowdown is adjustable from 8% down to 1% without chatter or pounding because steam cannot accumulate above valve disc.

The Foster 38-SV Safety Valve was especially designed for pressures up to 3000 pounds and temperatures up to 1000° F. In fact, they are now being tested at temperatures considerably above 1000° F. Investigate its many features and advantages by writing for Bulletin 25 today.

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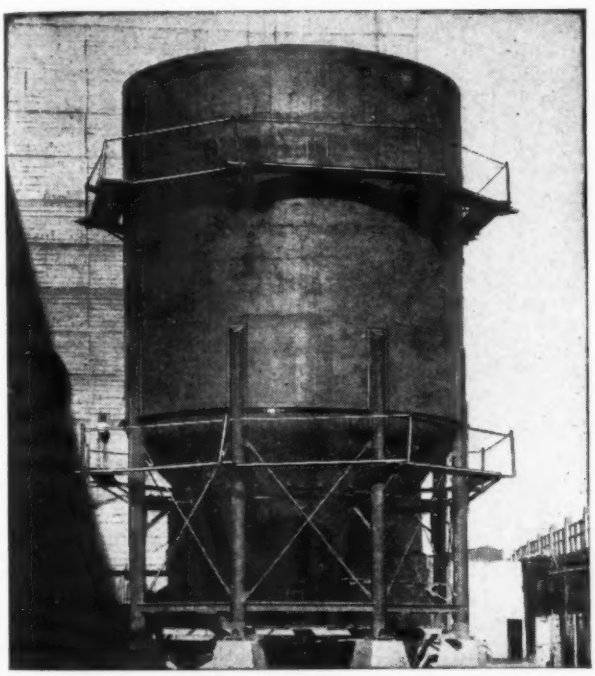
WATER CONDITIONING *Facts* WORTH KNOWING

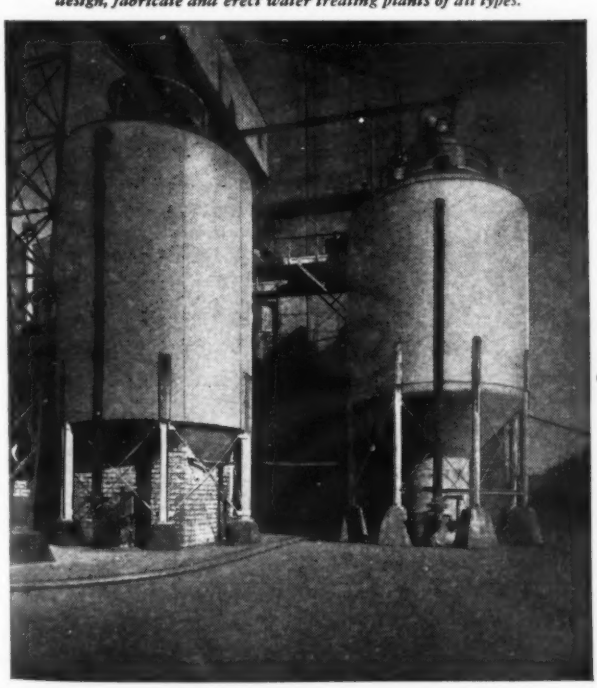
No. 8 in a series

GRAVER WATER CONDITIONING EQUIPMENT . . . DESIGNED, FABRICATED AND ERECTED BY SPECIALISTS



TOP: *Graver Hot Process Water Softener under construction at a Midwestern Processing plant.*

BOTTOM: *The finished installation—typical of Graver's ability to design, fabricate and erect water treating plants of all types.*



Successful treatment of boiler feed or process water depends not only on the type and amount of chemical feed, but also on the design and construction of the water treating equipment.

That's why we, here at Graver, take such pride in our staff of water treating specialists—experienced personnel ranging from the chemical engineers in the laboratory to the men welding tank seams in the field, all thoroughly familiar with the requirements of a successful water treating plant.

- Graver Chemical Engineers are eminently qualified by experience to recommend the type of treatment, and the size and type of equipment necessary for the treatment of any given raw water.
- Graver Structural Engineers are capable of designing such equipment in accordance with the best known standards for all types of gravity and pressure systems.
- Graver Field Engineers and Erectors are capable of erecting in the field the fabricated equipment for any type water treating plant.

These are the men who back Graver's ability to design, fabricate and erect water treating plants of all types under one undivided responsibility. Why not take advantage of Graver's complete service the next time a water treating problem confronts you? Write, wire or phone for immediate attention.

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Process Equipment Division of

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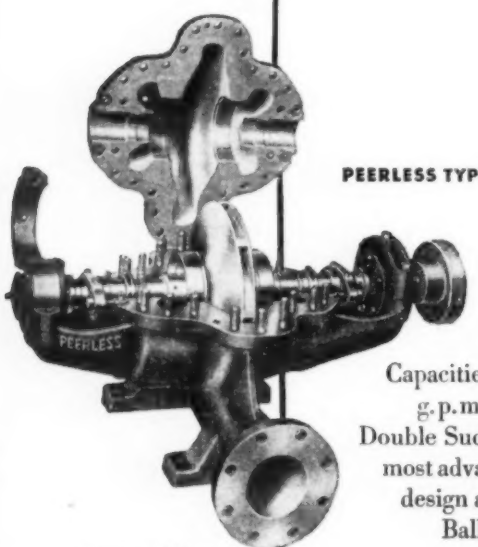
Effectively used in all types of industries where high-grade pumping is needed under stress of pressure and high temperatures. Peerless Centrifugal pumps can be furnished in other than standard specification metals and dimensions for special pumping problems.



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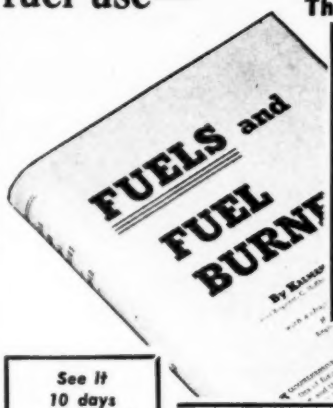

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of stokers, oil burners and gas burners —domestic and commercial plant use

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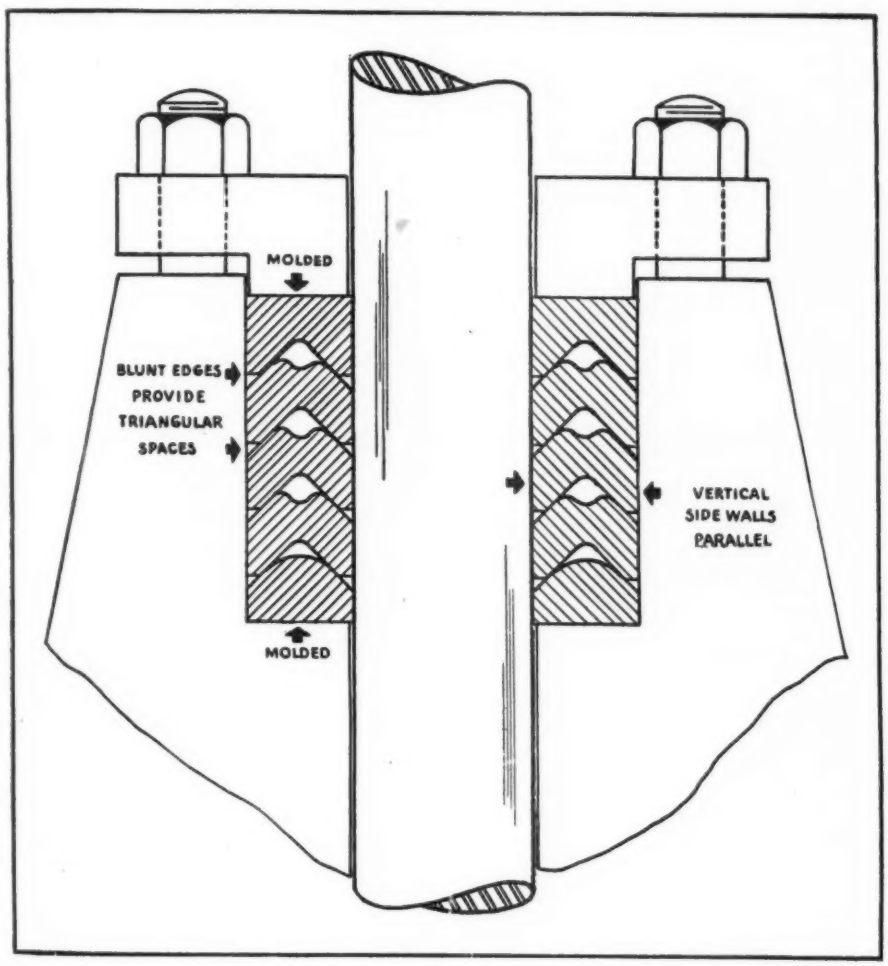

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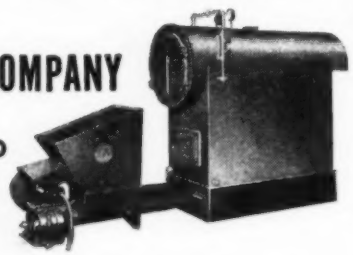

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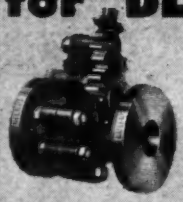
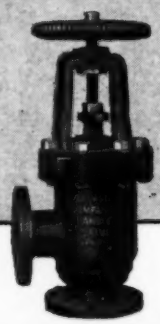
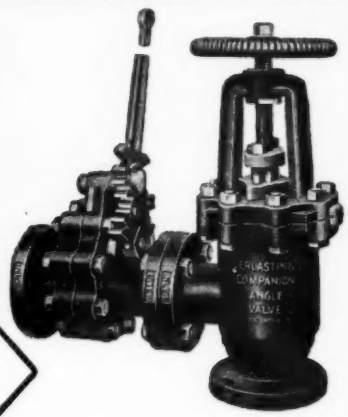


THIS IS THE SEALING VALVE

THIS IS THE BLOWING VALVE





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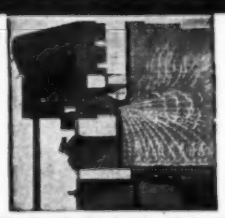

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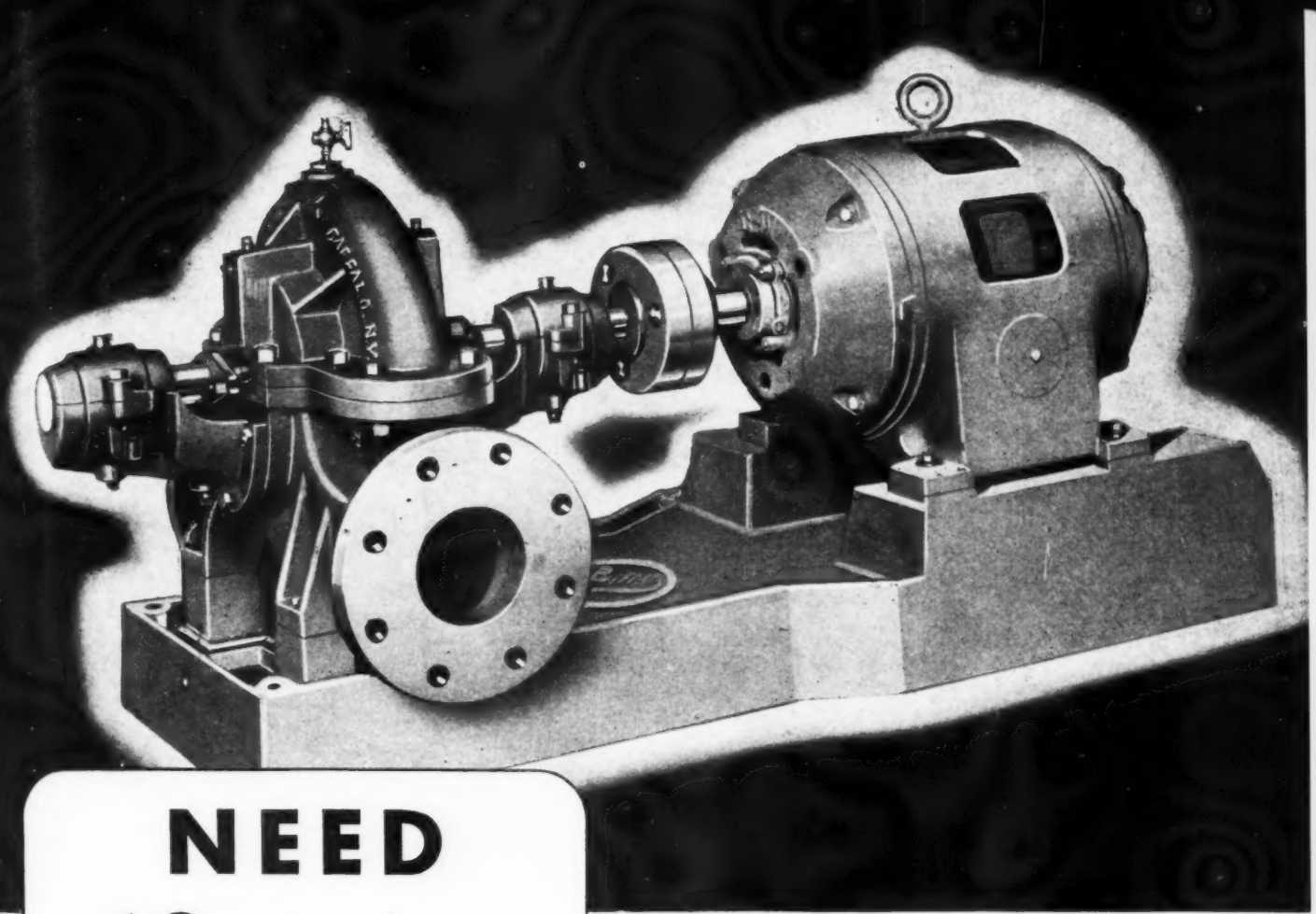

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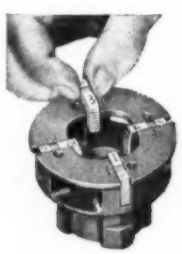
● Speedy and a worksaver, when you want to cut perfect threads on ⅛" to 1" pipe. This smart steel-and-malleable internal ratchet threader has precision-made heat-treated tool-steel dies, each factory tested . . . for smooth fast threading. Die heads snap in from either side, can't fall out. No special dies needed for close-to-wall work. No. 0R, ⅛" to 1"; No. 11R, ⅛" to 1¼." You'll like these durable efficient RIDGIDs for small pipe. Ask your Supply House.



Chasers easily reverse for close-to-wall threads.

RIDGID

WORK-SAVER PIPE TOOLS

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

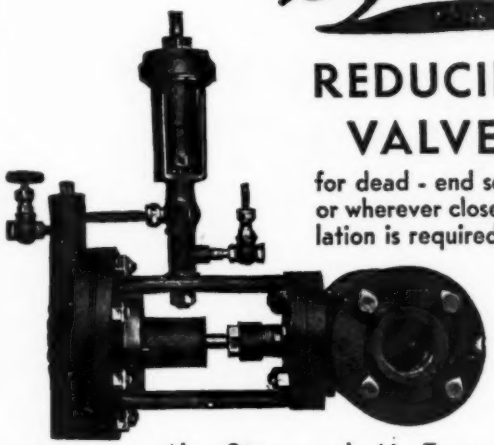
Use

THE GENUINE

Squires

REDUCING VALVES

for dead - end service, or wherever close regulation is required.



Also Steam and Air Traps, Pump Governors and Boiler Feed Water Controllers.

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HOPPES

FEEDWATER HEATERS

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Deaerating and Non-Deaerating

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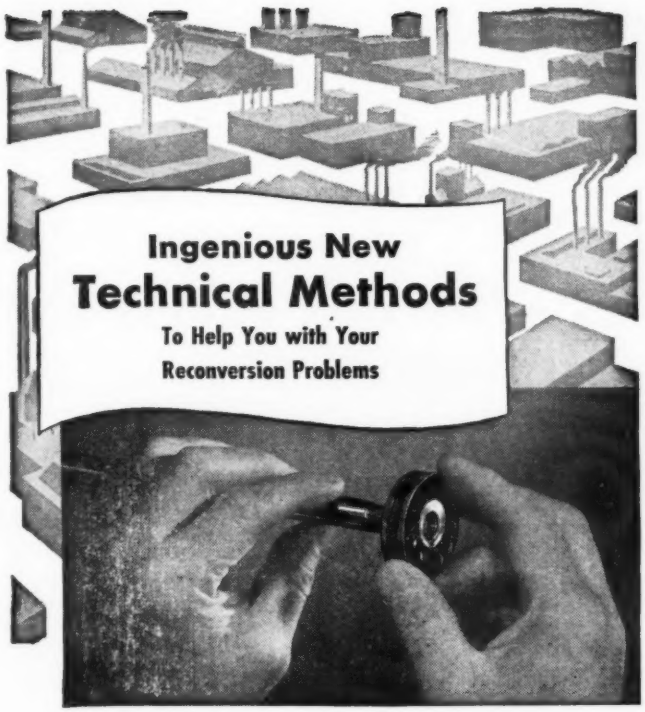
Write for Bulletin

THE HOPPES MFG. CO.

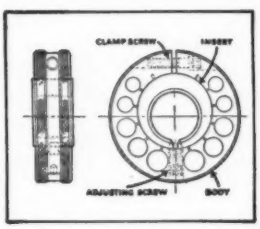
Established 1881

SPRINGFIELD OHIO



New Thread Ring Gage Starts Round Stays Round With Every Adjustment!

Employing a new principle of design, the Woodworth Thread Ring Gage closes in round within .0002 maximum after .005 adjustment. It offers greater accuracy and stability since size adjustment is controlled along thread helix angle. Threads are held securely in alignment after adjustment, due to unique adjustment means. Wear is distributed over full circumference for all resettings, thus increasing life of gage.



Woodworth Thread Ring Gage

Positive adjustment makes it almost impossible to change setting with ordinary knocks. Positive identification by a green "go" gage and red "not go" gage saves operator time. Aluminum alloy outer body cuts weight in half, to reduce operator fatigue and increase sensitivity.

To also reduce fatigue on precision jobs, many plant owners make chewing gum available for workers. Tests show that the act of chewing aids in relieving tension, which is often the cause of fatigue. These tests further reveal that chewing Wrigley's Spearmint Gum, for instance, helps workers stay alert, thus increases their efficiency to do more accurate work.

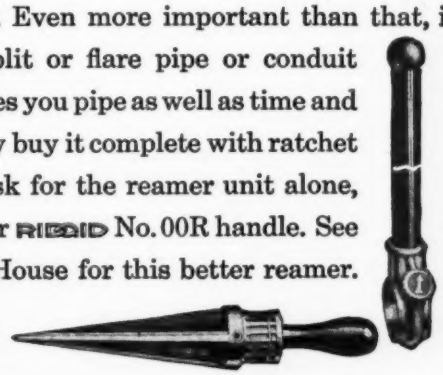
You can get complete information from
N. A. Woodworth Company
1300 East Nine Mile Road
Detroit 20, Michigan

AA-94

RIDGID

LonGriP Pipe Reamer

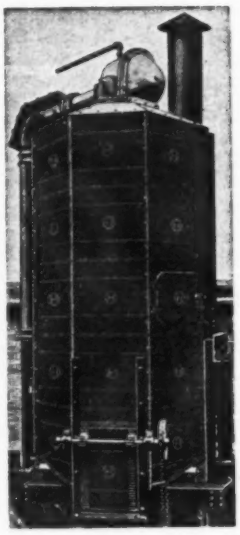
● The trick of its efficient performance is in that extra long taper—it reams burr cleanly from any pipe in a few easy ratcheted strokes—practically no pressure required. Even more important than that, it won't thin, split or flare pipe or conduit wall. That saves you pipe as well as time and work. You may buy it complete with ratchet handle—or ask for the reamer unit alone, which fits your RIDGID No. 00R handle. See your Supply House for this better reamer.



Reamer unit fits RIDGID No. 00R handle.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

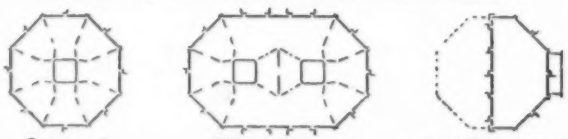
PIPE-LINE or PNEUMATIC CONVEYORS for ASHES and FLY-ASH



"Most economical in steam-consumption and maintenance." Design of every part, fitting, etc., based on our experience of 25 years with the successful manufacture and operation of this type of conveyors and on our full appreciation of their special requirements.

We also specialize in improving existing conveyors through our superior fittings and frequently through rearrangement of present layouts.

CAST IRON SECTIONAL ASH TANKS, COAL BUNKERS, BINS, HOPPERS and SILOS

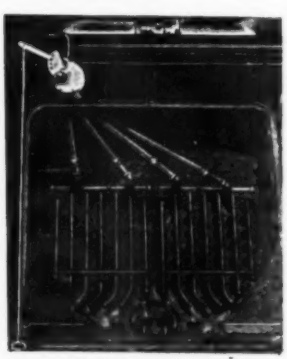


Octagonal | Oblong-Octagonal | Semi-Octagonal

Durability combined with our exclusive discharge-efficient and self-clearing designs, preventing arching, packing and spontaneous combustion in case of coal bunkers and also obviating the necessity of hazardous trimming.

MECHANICAL SOOT BLOWERS for FIRE-TUBE BOILERS of ALL TYPES

Fixed nozzle centered to each tube. No cutting of tube-sheet. No moving parts in hot boiler. All tubes in boiler blown with four successive puffs of steam or air in about one minute. Perfect soot-removal from each tube END TO END.



Mechanical Soot Blower with H. R. T. Boiler

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(Formerly Hahn Engineering Co.)

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A *Simple* WAY TO MAKE ENDS MEET . . .

MagniLastic OFFSET JOINTS

At last a scientifically designed unit is available to correct an adverse piping condition: parallel misalignment or offset between pipe sections. Makeshift measures that can severely strain an installation are no longer necessary. Once a custom unit only, MagniLastic Offset Joints can now be supplied direct from the new MagniLastic catalog, in standard design but for any pipe size and offset requirement.

CAUSES OF OFFSET CONDITION:

Wherever piping is installed, misalignment between adjacent terminals may exist. This can be due to accumulated tolerances in successive piping sections, to settling or shifting at anchored points and hangers, or to variations in operating conditions. In addition to "making ends meet", Offset Joints protect valves, headers and fittings from undue strain or tension due to misalignment.

SPECIFICATIONS FOR OFFSET JOINTS:

MagniLastic Offset Joints are supplied with bellows flanges from any of the standard MagniLastic Expansion Joint pressure series. These include vacuum to 25 psi Copper, 55 psi Monel, 150 psi, 400 psi, and 1000 psi Stainless Steel. Pipe sizes range from ½ to 24 inches. End fittings may be specified either Van Stone Standard flanges or welding ends. Length of unit and number of bellows flanges depends on offset condition to be corrected, but is easily calculated from data given in the catalog.

What Is Misalignment?

Three common conditions of misalignment in piping connections are:

1 LATERAL: Amount is specified in degrees, and correction made with standard MagniLastic Expansion Joints, allowing one bellows flange for each 2° of lateral deflection.

2 PARALLEL: Amount is specified in inches, and correction made with MagniLastic Offset Joints. Overall length varies with amount of offset.

3 ANGULAR: Amount is specified in both degrees and inches. Recommendations should be obtained from MagniLastic for correction of each condition.

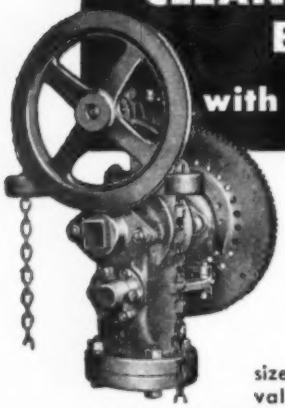
MAGNILASTIC

DIVISION OF
COOK ELECTRIC COMPANY
Chicago

Sales and Engineering Offices in Principal Cities

Do you have a copy of the newly revised MagniLastic Catalog, describing not only Standard Packless Expansion and Offset Joints, but the new MagniLastic Anchor, Turbo and Jacket Joints? If not, just drop us a line requesting Catalog 212M.

CLEAN and PROTECT BOILERS with THE MARION LINE SOOT BLOWERS



● Increase your power plant efficiency at low cost—install Marion Soot Blowers! Type "F", illustrated, removes soot and ash deposits completely from water tube boilers of any type or size. It is equipped with automatic valve, balanced, chain-driven gear-operated head with flexible mounting to accommodate shifting of tube and wall positions due to heat changes.

Elements, in approved material for temperature and corrosive conditions, are adjustable 3" lengthwise for nozzle alignment. Internally welded nozzles have full Venturi opening to spread steam for deep penetration without pitting tubes. Blowing range quickly adjustable from 45 to 345 degree arc in increments of 6½ degrees.

Valve opening requires 10 to 20 lbs. chain pull, then "free wheels" at 3 to 5 lbs. All parts are interchangeable. Installation is simple and balanced valve is accessible for inspection or regrinding. Made for any usual working pressure. Operated with air or steam. Products of 40 years' manufacturing experience.

Write for Catalog F-45 describing all types of Marion Soot Blowers

Marion Machine, Foundry & Supply Co., Marion, Ind., U.S.A.

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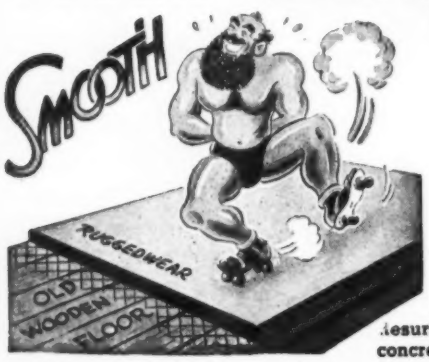

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The glow from the open furnace door below the grating illustrates the maximum light, ventilation and the ease of maintenance that goes with BATES • GRATES. Normal cleaning routine keeps the floors in new-floor condition — clean and safe.

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Up the stairs or along the walkways, BATES • GRATES are safer, stronger, more durable.

THESE are the features you want in open steel flooring and stair treads: Strength, safety, ease of maintenance, durability, good underfloor lighting and maximum ventilation.

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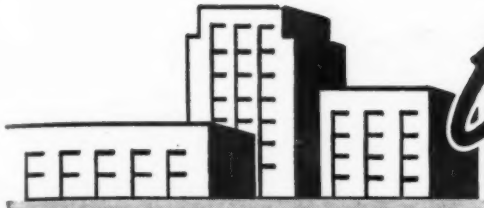

Your OIC valve distributor

SERVES YOU IN MANY WAYS

Your industrial distributor is a good man to do business with . . . a good friend to have in emergencies . . . a source of constant aid to your operations. He is a member of your business community, so he understands your problems and tries to anticipate your needs. He's close at hand when you need him. Here are just a few of the countless ways in which he serves you:

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Your OIC valve distributor knows your needs and tries to maintain his stocks accordingly. That enables you to keep your own parts and materials inventories low . . . saving you capital investment, storekeeping expense and loss from obsolescence.

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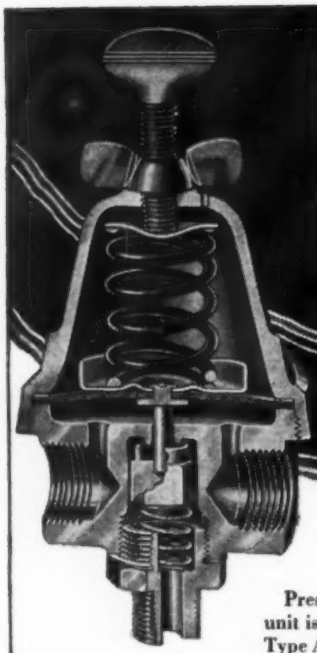
STEEL • IRON • BRONZE VALVES

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

FULL fluid flow!



Type A-31-3way
¼ Actual Size

Pressure regulation in a small unit is available in a CASH·ACME Type A-31 Small Volume Pressure Reducing & Regulating Valve for Water, Air, Gas, etc.

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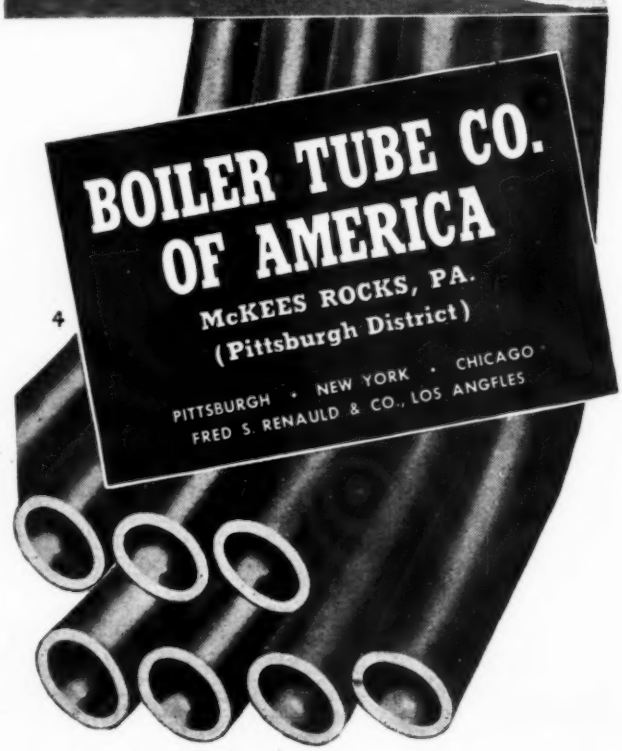

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100% AUTOMATIC

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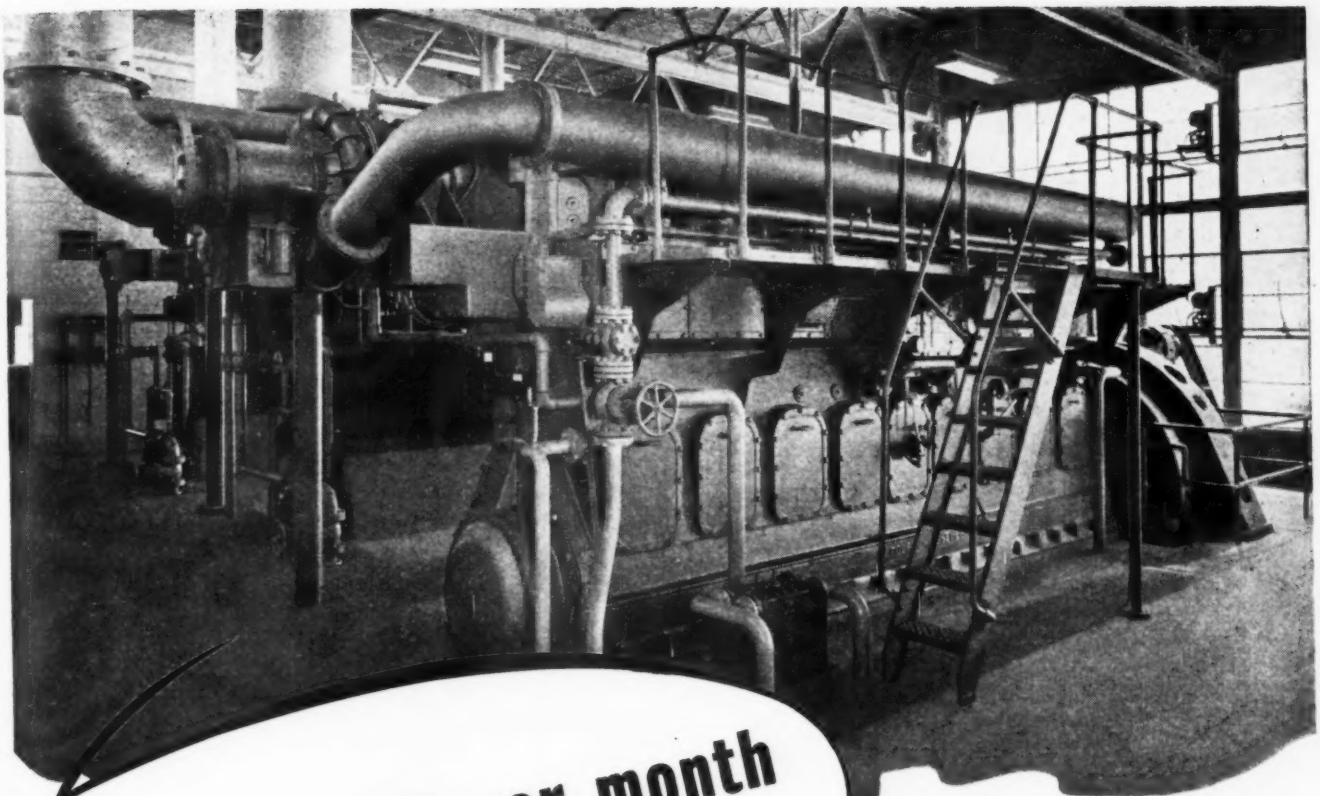

Saves $100 per month in fuel alone!

New 1437 hp Cooper-Bessemer Type LS 8-cylinder supercharged Diesel recently installed in Portland, Michigan plant of Tri Counties Electric Cooperative. Plant's original atmospheric engines, also Cooper-Bessemers, are visible in background. New engine relieved tight load situation and permitted overhaul of the older units, their first in 22,000 hours.

For a single engine to save 100 dollars per month in fuel cost is nothing to be sneezed at in anybody's power plant. This is the comparative saving now afforded by a Cooper-Bessemer supercharged Diesel recently installed in the Portland, Michigan plant of the Tri Counties Electric Cooperative.

This well-managed plant has two other Diesels . . . five-year-old Cooper-Bessemer Type JS's. Through years of gruelling wartime service, despite frequent 10 to 25% overloads, these engines have given the kind of trouble-free service that leads users to re-specify Cooper-Bessemers whenever additional capacity is needed.

Supercharged, the new Diesel not only brings fuel economy impossible with any atmospheric engine, but it has a capacity equal to both the original engines with only a negligible increase in length.

Whatever your engine requirements may be, 100 to 2000 horsepower, supercharged or atmospheric, there is a modern Cooper-Bessemer that will give you engine performance at its best.

The
Cooper-Bessemer
Corporation

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Rough and Ready Airetool Tube Cleaners can "take on" any tube cleaning job in a steam generating plant and quickly restore operating efficiency.

Even though they are rugged, Airetool Tube Cleaners are fine precision tools. The exclusive New Form cutter design, eliminates tracking and tube damage. Airetool motors with their patented Power Seal and Balanced Rotor develop 28% more power, can be loaded down to 50 rpm without stalling and maintain constant torque at low speeds.

Illustrated is Airetool's No. 4325 cleaner with 3270 Forwardly Swing Arm type head for 3" I.D. curved tubes of short radii. Other cleaners are available in sizes for tubes ½" to 12" I.D.

The RIGHT Expander

Airetool Tube Expanders are designed to perform specific tube rolling jobs—we have the right expander for every job. Airetool Expanders are built of heat-treated steels which maintain a uniform hardness and grain structure throughout each tool.

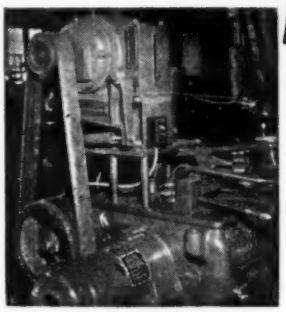
Write Dept. P for helpful bulletins on cleaners and expanders.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

On a big fellow like this

A 36" heavy four-ply Tannate leather belt driving an ammonia compressor for more than four years. 600-800 H.P. load. 6100 F.P.M. Giving excellent service. Pulley ratios are bad, speed high and load heavy.

Or a little fellow like this



A vertical base type Rockwood Flat Belt drive operating a lathe in a metal working plant.

Tannate WATERSHED

LEATHER BELTING assures

. . . more delivered power
. . . greater efficiency
. . . lower maintenance

Whether driven from long or short centers, with group or individual drives—your machines are most reliably belted with Tannate flat leather.

It has very high coefficient of friction and great pliability that helps keep your machines running at full capacity; this means increased output at lowered unit cost.

Tannate has unusually high tensile strength which contributes toward increased service life, and lower end cost. It is treated to resist moisture, oil and weak acids; it stays on the job . . . requires little maintenance.

Tannate leather belting, through decades of use on industries' really tough drives, large and small, has proved really good. May we show you where it can benefit you?

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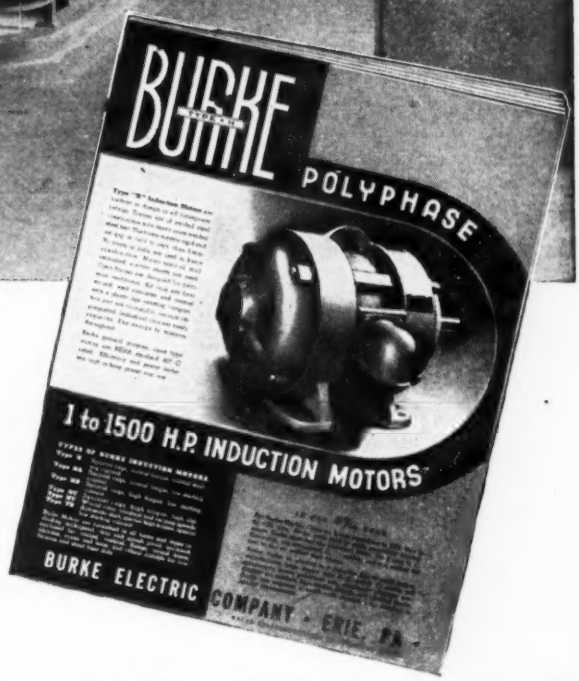
BURKE MOTORS DRIVE MAIN SEWAGE PUMPS



At Bowery Bay

NEW YORK CITY'S MODERN, ACTIVATED-SLUDGE, SEWAGE TREATMENT PLANT

Burke motors drive the main pumps that deliver the raw sewage from incoming lines to the treatment process. These specially designed motors were selected for day in and day out dependability—they are both efficient and extremely rugged for long life.

They are Wound Rotor, adjustable, varying speed, vertical type with welded steel frames, oil lubricated ball bearings, solid shafts, drip-proof covers and high ring bases. Stators are designed for operation on 208, Volt, 60 Cycle, 3 phase power supply.

Two 400 H.P. 400 RPM Burke Induction Motors in foreground—two 200 H.P. 600 RPM motors in background. Motorspeeds vary between 85 and 100 percent to maintain the most efficient head on the pumps. Motor speed controls are automatically actuated by a wet well float. Write for Bulletin 101 A and for recommendations.

Consult either Sweets or EBR catalogs for the complete line of Burke AC & DC equipment.

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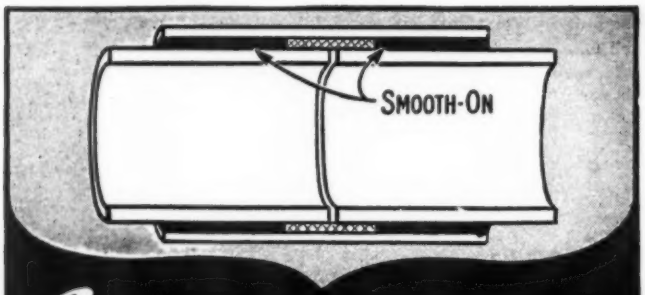
MOTORS 1 TO 1500 H. P. • GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • *Since 1891*



Easy EMERGENCY REPAIR

AVERTED STEAM STOPPAGE *in very cold weather*

In a Kansas power plant an anchor block slipped and caused a steam line to tear itself out of 8-in. flanges. Read how the plant superintendent averted a serious service interruption.

On removing the broken flanges, he found that the pipe couldn't be gotten back into flanges again. So he enclosed the open ends in a sleeve of slightly larger cast iron pipe and packed oakum tightly around the gap. Then the entire sleeve was tamped full of Smooth-On No. 1 Iron Repair Cement.

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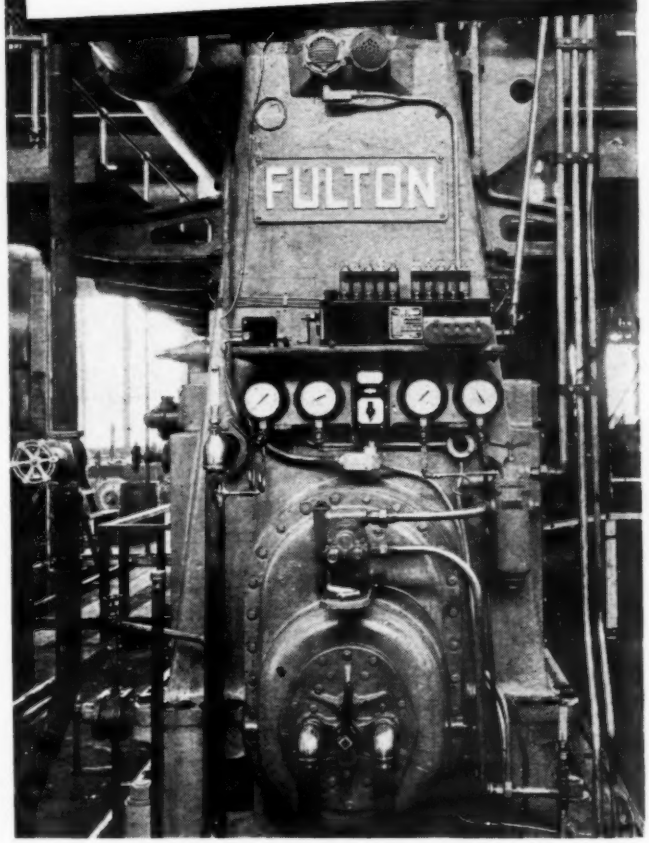

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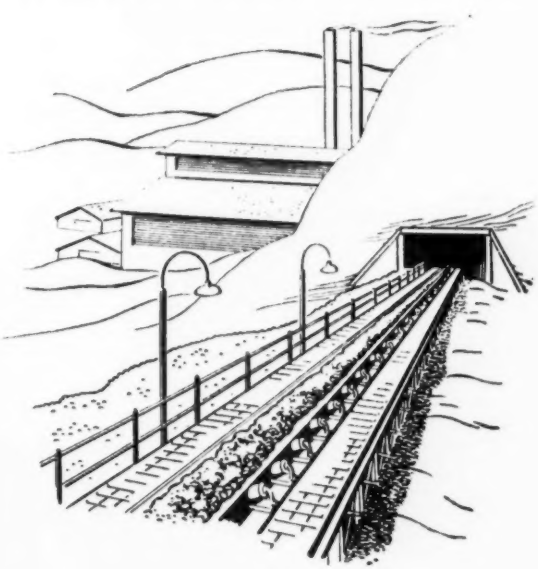

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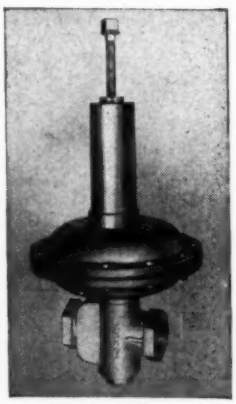

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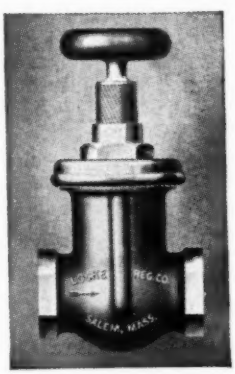

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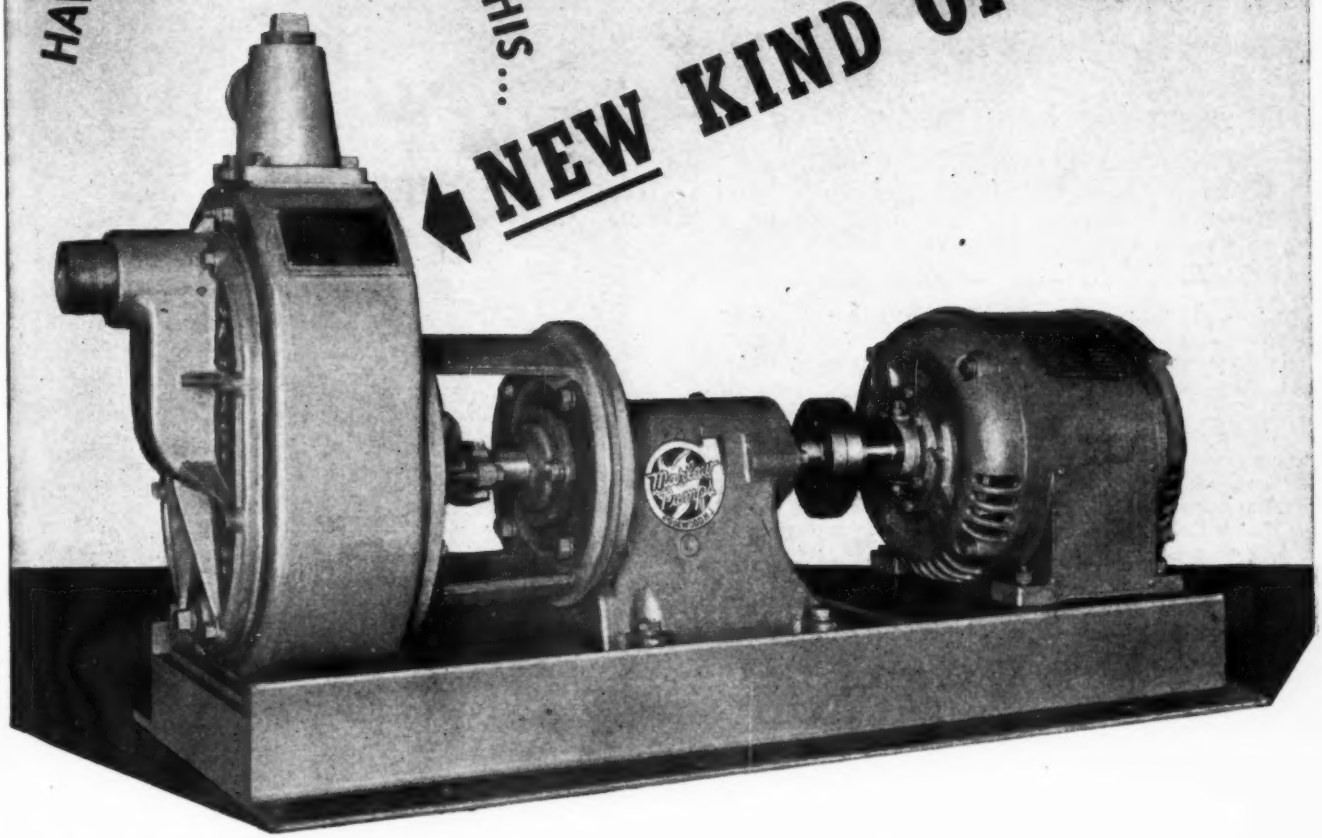

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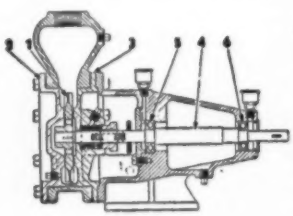

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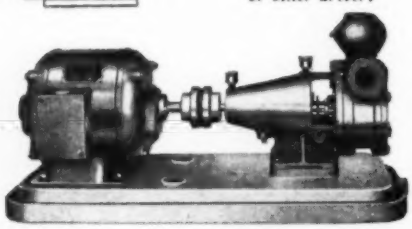

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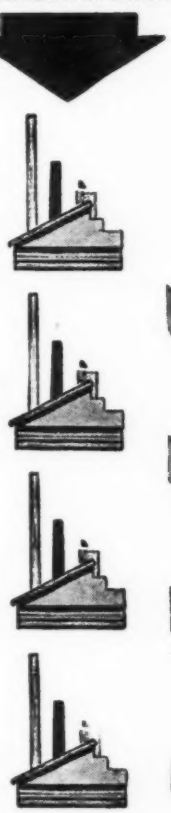

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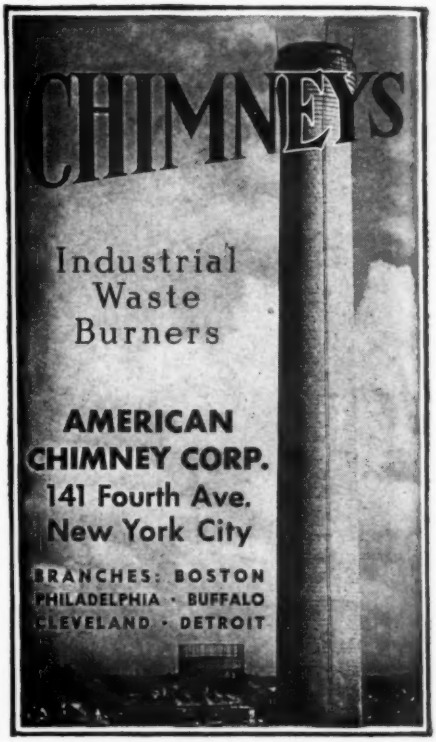

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for the most efficient

INDUSTRIAL OIL BURNER

on the market. This burner does not require any special combustion chamber, is easily installed and needs little or no service since it has no moving parts. Agent must have some engineering background and established contacts with architects, industrial and heating engineers, contractors and principal industries in area. This is a serious proposition offering excellent earning possibilities to individual or agency of integrity and ability. Financial and character references required. Include all background information with your first letter.

RW 187 Power,
330 West 42 St., New York 18, N. Y.

WANTED

Sales Representatives

Have a few good territory openings for aggressive sales representatives. An old established line of plastic insulation that has been proven successful on all types of boilers, boiler-room equipment, tanks, pipes, furnaces of all types, open hearth, reheat, etc. The line is well advertised and backed by an old, well-financed corporation. This is a real opportunity. State experience and territory wanted. Address

RW-162, Power
520 North Michigan Ave., Chicago 11, Ill.

DRAFTSMEN

DESIGNERS AND CHECKERS
with experience on
Structural Steel and Concrete
Process Piping
Pressure Vessels

The Boston office of E. B. Badger and Sons Co., internationally famous chemical engineering organization, offers qualified men well-paying positions. This is a fine opportunity for men who would enjoy working in congenial surroundings and with pleasant cooperative associates. A personal interview can be arranged in your city. This is not a temporary position. Write, giving full details of background and experience, salary wanted, etc., to

Mr. William M. Rose, Personnel Director
E. B. Badger and Sons Co.
75 Pitts Street, Boston, Mass.

WANTED

ELECTRICAL ENGINEER

For Power Plant Design
Must have Public Utility Experience

WESTCOTT & MAPES, INC.
New Haven Connecticut

Engineer Wanted

To be chief engineer of company manufacturing pumps both reciprocating and centrifugal. Also welded chemical process equipment. Company well established for many years. Applicant should have an engineering degree, age 30-45, married and at least 5 years experience in such work. Please reply giving employment history and salary desired. All replies will be held confidential. Address

P-191, Power
520 North Michigan Ave., Chicago 11, Ill.

(Additional Employment Ads on page 334)

WANTED

(Additional Equipment Wanted Ads on page 362)

WANTED

EXPLOSION PROOF

AND

TOTALLY ENCLOSED

ELECTRIC MOTORS

ALL SIZES — ANY QUANTITY — *New or Used*

AMERICAN ELECTRICAL EQUIPMENT CORP

59 Edison Place — *Market 2-5454-5* — Newark 2, N. J.

WANTED

SALES REPRESENTATIVES

Long established and progressive manufacturer of Pump Valves and Steam Specialties has several good territory openings for aggressive sales representatives. State experience and territory desired.

RW-190, Power
330 West 42nd St., New York 18, N. Y.

MANUFACTURERS'

AGENTS

Wanted in Atlanta, Buffalo, Chicago, Cincinnati, Pittsburgh and Minneapolis by an old-established manufacturer of pulverized fuel burning equipment. Generous commissions. Only well-established and self-supporting agencies need apply. Those having other, but non-competitive, power plant accounts preferred.

RW-188, Power
520 North Michigan Ave., Chicago 11, Ill.

WANTED

Complete Power House

Boiler Capacity 90,000 to 120,000 lbs. Steam per hour. 600# W. P. Superheaters, etc. Oil or Pulverized Coal.

2—4000 to 6000 K.W. Turbo Generators, 13,800 volts. 600# Throttle Pressure, Extraction 150#, Condensing Type.

J. Parker Thompson Co., Inc.

507 Fifth Avenue — New York 17, N. Y.
Phone Murray Hill 2-5740

Cash Ready

FOR YOUR

ELECTRICAL EQUIPMENT

Electric motors, AC and DC
Compensators
Generators
Motor Generator Sets
Air and Oil Circuit Breakers
Panels
Exhaust Fans
Control Equipment

Send us list with full details

WIRE OR PHONE
P. O. Box 534

POWER EQUIPMENT CO.

373 30. GOODMAN ST., ROCHESTER 7, N. Y.
Phone Hillside 2041

OPPORTUNITY!

We are a reputable principal
READY to **PAY YOU CASH**

For quick purchase on
INDUSTRIAL PLANTS—MFG. DIVS. or UNITS (assets or capital stock)

FOR IMMEDIATE ACTION IN THE STRICTEST CONFIDENCE

Address: Box No. 1234 147 W. 42 St., New York, 18
Personnel will be retained wherever possible.

WANTED TO BUY

One (1) 125 HP. Boiler and Stack. Must pass insurance for 150 pound working pressure.

CRYSTAL ICE WORKS, INC.
P. O. Box 98 — Bartow, Fla.

WANTED

2—300 H.P. Boilers with stokers in exchange for

2—600 H.P. Springfield Crossdrum Boilers complete with Harrington stokers, including steel structure, soot blowers, superheaters, forced draft fan and vertical reciprocating steam engine 8x8. Approved for 200# working pressure. Completely dismantled ready for immediate shipment.

MIDWEST MFG. COMPANY
Galesburg, Illinois

OPPORTUNITY

Owner selling only exclusively dynamic and static balancing bus. in ind. area 4,000,000 pop. now in oper. and for past 18 years. Net profit last 12 operating mos. over $2,000 per mo. Books can be audited by bona fide prospective buyer. Actual inventory value of land, bldg. and equipment $30,000.

Owner retiring, will accept offer at inventory value, plus reasonable amount for good will to be agreed upon after prospective buyer has interviewed present customers, and seen possibilities.

Present personnel will remain to assist. Temporary living quarters available. Write

Box 782, Preuss Station
Los Angeles 35, California

WANTED

2000 k. w. Condensing Turbine

3 phase, 60 cycles, 200# pressure, 23-2400 volts, complete with condenser and auxiliaries, switch board and instruments. Specify all details as to age, stages, length of service, etc., location and price.

HOPE WATER & LIGHT PLANT
Hope, Arkansas

WE NEED MOTORS!

1½ HP—Single Phase
1750 R.P.M.—Ball Bearing

One or more—any quantity—any make!
Wire collect, quoting price and quantity.

KENT ENGINEERING COMPANY
3000 Hyde Park Boulevard, Los Angeles, California

Air Compressors Wanted

Horizontal Water Cooled—Any size also 2 Stage portable units

L. W. BAUER
North Bergen, N. J.

If **THIS—OR ANY—ISSUE OF**

POWER

does not contain the information you want, about products, specialties or services, please write us.

POWER
330 W. 42 St., New York 18, N.Y.

WHEN YOU BUY USED EQUIPMENT LOOK FOR THIS SEAL OF VALUE

The Hemphill Seal assures you that the Hemphill Equipment you buy is good equipment. When we rebuild and test, it is done under the supervision of our own Electrical Engineers. And we guarantee its service. Remember these facts before you invest your money.

HEMPHILL EQUIPMENT IS GUARANTEED

MOTOR GENERATOR SETS

1—300 K.W. G. E. 275V, 3 unit syn. motor 2200 volt, 720 RPM.
1—150 K.W. Westinghouse 125 V. Sq. Cg. 220 V. 3 phase 900 RPM.
1—125—K. W. Crocker-Wheeler 125 V. Sq. Cg. 2300 V. 3 phase, 1200 RPM.
2—100 K.W. G. E. 230 V. A. C. Sq. Cg. 440 V. 3 phase, 60 cy. 1200 RPM.
1—80 K W. Crocker-Wheeler 3 unit 125 V. Syn. Motor, 220 V.
6—17 K.W. Allis-Chalmers 3 unit 120 V. Sq. Cg. 220 V. 1800 RPM.

ENGINE GENERATOR SETS

1—150 KVA. G.E. Ames Unaflow Engine, non-condensing.
1—120 K.W. Gasoline driven G.E. with Van Blerck Engine.

TURBO GENERATORS

1—600 KW. Terry dual bleeder condensing Turbine only
1—300 KW. 125/250 Volt. General Electric non-condensing
1—300 KW. General Electric, 3 phase, 60 cycle, 220 volt cond.
1—30 KW. 135 volt, Allis-Chalmers, non-cond.

TRANSFORMERS

1—1000 KVA. Auto Transf. 4150 V. 3 Ph. 4 wire to 2400 V. 2 Ph.
3—200 KVA. Pittsburgh 2200 volt 110/220
3—1000 KVA. Westinghouse 11430/250 volt.
3—100 KVA. General Electric 13200/250 volt
3— 75 KVA. General Electric 13500/750/440 volt
2— 50 KVA. Pittsburgh 7500/15000 V. 110/220 v.

ALTERNATORS

1—500 KW, 3600 RPM. 600 volt, General Electric D.C. exciter
1—200 KVA. 3600 RPM. 240 volt, Allis-Chalmers D.C. exciter
1—180 KW. 514 RPM. 550 volt, Westinghouse
1—165 KW. 514 RPM. 2400 volt, Electric Mach.
1—62½ KW. 3600 RPM. 220 volt, Allis-Chalmers
1—40 KW. 1800 RPM. 550 volt, General Electric
1—35 KW. 1200 RPM. 240 volt, Columbia Electric D.C. exciter
1—31.3 KVA. 1280 RPM. 120/280 volt, American D.C. exciter
1—12.5 KVA. 1200 RPM. 240 volt, Westinghouse, D.C. exciter

MOTORS—VARIABLE SPEED

230 VOLT

2—200 H.P. 425/212 RPM. General Electric MPC
2—100 H.P. 950/1170 RPM. General Electric RC-37
1—.40 H.P. 755/1000 RPM. Sprague LC.
1— 30 H.P. 400/120 RPM. General Electric RC-204
1— 25 H.P. 650/2200 RPM. Westinghouse SK1110L
1— 25 H.P. 500/1500 RPM. General Electric RF-12
1— 25 H.P. 400/1200 RPM. Westinghouse SK
2— 25 H.P. 300/900 RPM. Electro Dynamic
1— 15 H.P. 300/1200 RPM. General Electric RLC-2024
1—13/18 H.P. 350/1200 RPM. Electro Dynamic
3—11½ H.P. 500/1500 RPM. Westinghouse
1—7½/10 H.P. 500/1500 RPM. Reliance
1—6/7.5 H.P. 450/1800 RPM. Crocker-Wheeler CMC
1—5 H.P. 500/1500 RPM. Reliance
1—5 H.P. 600/1200 RPM. General Electric LC
1—5 H.P. 450/1800 RPM. Crocker-Wheeler CM
1—5 H.P. 400/1600 RPM. Diehl K6
1—5 H.P. 225/900 RPM. Electro-Dynamic

MOTORS 3 PHASE 60 CYCLE

SLIP RING

1—500 H.P. 900 RPM. Lincoln 440 volt
1—350 H.P. 203 RPM. General Electric MT-424 440 volt
1—225 H.P. 1800 RPM. General Electric I-L 220 volt
1—200 H.P. 600 RPM. Crocker-Wheeler S.R. 440 volt
1—200 H.P. 600 RPM. Westinghouse CW 220 volt
1— 75 H.P. 900 RPM. General Electric ITC 220 volt
1— 40 H.P. 1150 RPM. Cont Electric SA85 220 volt
1— 40 H.P. 1130 RPM. General Electric Mt. 2200 volt

MOTORS 3 PHASE 60 CYCLE

SQUIRREL CAGE

1—400 H.P. 1200 RPM. Westinghouse 220 volt
1—200 H.P. 1200 G.E. 1K. 2200
2—100 H.P. 1200 RPM. General Electric, 220 volt, type KT and KF
1— 90 H.P. 380 RPM. Crocker-Wheeler 550 volt
1— 75 H.P. 690 RPM. Westinghouse 550 volt
2— 50 H.P. 900 RPM. Fairbanks-Morse H. 220 volt
2— 25 H.P. 1800/1200/900/600 U. S., 440 volt, 3 phase

D. C. GENERATORS

1—300 K.W. 250 V. G.E. MPC 1060 RPM
2—250 K.W. 250 V. Crocker-Wheeler Gen. 1200 RPM
1— 75 K.W. 250 V. Westinghouse 260 RPM
1— 50 K.W. 115 V. Westinghouse 1200 RPM
2—31.25 K.W. 125 V. Westinghouse 1400 RPM
2— 20 K.W. 50 V. G.E. 1800 RPM

MOTORS D.C.

230 VOLTS

2—450 H.P. General Electric MPL 250 volt 400 RPM
1—250 H.P. 750 RPM. Electro Dynamic 230 volt
1—125 H.P. 1725 RPM. General Electric RC-230 volt
1— 75 H.P. 575 RPM. General Electric C230 volt
2— 50 H.P. 700 RPM. Crocker-Wheeler CM 230 volt
2— 30 H.P. 1150 RPM. General Electric RC-31 230 volt
1— 30 H.P. 1100 RPM. General Electric RC-12 230 volt
1— 30 H.P. 750 RPM. General Electric RC-14 230 volt
1— 30 H.P. 625 RPM. General Electric C 230 volt
1— 25 H.P. 600 RPM. Westinghouse SK 230 volt
1— 20 H.P. 800 RPM. General Electric RC 12 230 volt
1— 15 H.P. 350 RPM. Diehl G-312 230 volt

SYNCHRONOUS MOTORS

1—500 KVA. G.E. 900 RPM. ATI 4150 V. D.C. exciter
2—160 H.P. Elec. Mach. 1800 RPM. 2200 V DC. exciter
1—100 H.P. G.E. type TS, 600 RPM. 440 volt D.C. Exciter.
1—75 H.P. G.E. 1200 RPM. ATI 220 V. 3 phase
2—50 H.P. G.E. 1800 RPM. TS 220 V.
1—50 H.P. G.E. 1800 RPM. ATI 20 V. D.C. exciter
1—35 KVA. G.E. 1200 RPM. ATI 2200 V. D.C. exciter
1—20 H.P. Westinghouse 1800 RPM. 220 V. .8 P.F.

FREQUENCY CHANGERS

1—7½ K.W. 15 KVA 50% P.F. 1800 RPM. 215 V. 270 Cy. C.W. Westinghouse
2—15 K.W. G.E. Type MM, 270 cy.

VERTICAL MOTORS

4—100 G.E. Vert. Hollow Shaft 1200 RPM. 220 S.C.
1— 75 G.E. Vert. Solid Shaft 1200 RPM. 220 S.R.
1— 60 Westinghouse Solid Shaft 900 RPM. 200 S.R.

MISCELLANEOUS

2—2100 Gallon Pumps Dayton-Dowd 100 foot head
4—12,000 GPM. 21' head Axial Flow Vertical Pumps with Motors

THIS SEAL IS YOUR GUARANTEE

"FOR POWER"

J.L. HEMPHILL & CO.

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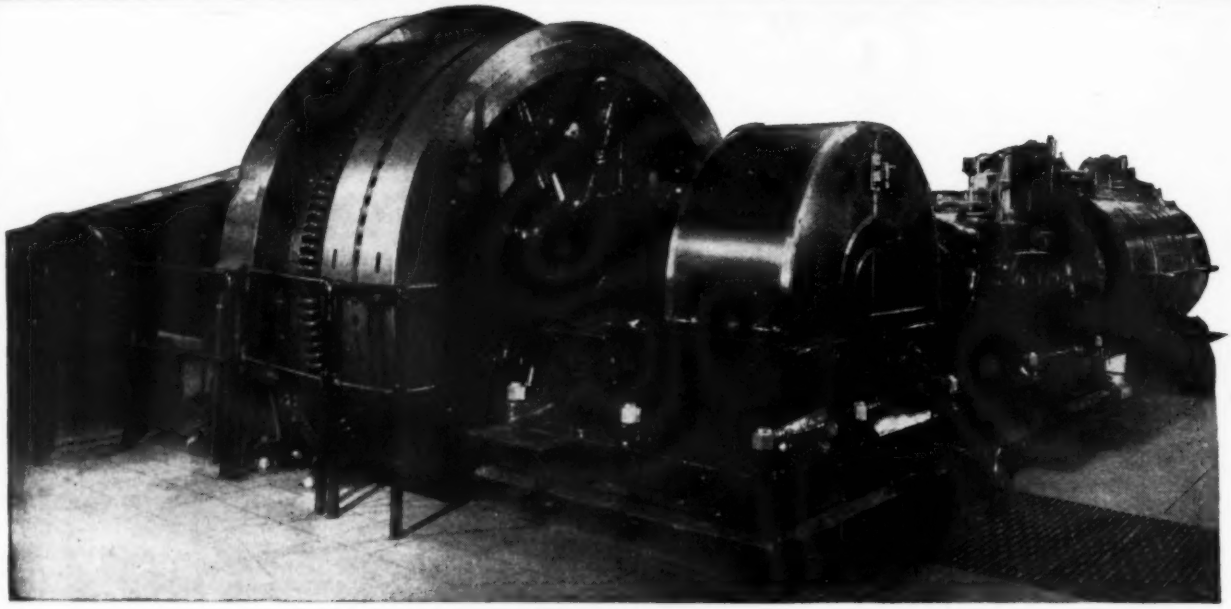
PHONE NEW YORK—LONGACRE 5-3227
PHONE NEW JERSEY—UNION 3-2600



Actual Photograph

1000 KVA SKINNER UNIFLOW ENGINE GENERATOR UNIT

800 KW 80% P.F. 1000 KVA General Electric alternating current generator 3 phase 60 cycle 2300/600/480/240 volts 150 RPM direct connected to Skinner Universal Uniflow noncondensing engine, 125# steam pressure, 0-3# back pressure, complete with auxiliaries.

TURBINE UNITS
Condensing
3 phase 60 cycle

3750 KVA Wstgh.	4160 V. 200#
2500 KVA G.E.	2300 V. 200#
1875 KVA G.E.	2300 V. 175#
1250 KVA G.E.	2300 V. 175#
937 KVA G.E.	2300 V. 150#
625 KVA G.E.	240 V. 200#
625 KVA G.E.	2300 V. 170#

TURBINE UNITS
Automatic Extraction
3 phase 60 cycle

3650 KVA Wstgh. 2300 V. 150#, 10# Extraction

1250 KVA G.E. 2300 V. 150#, 10# Extraction

1250 KVA Allis 480 V. 300#, 35# Extraction

1250 KVA Allis 480 V. 150#, 12# Extraction

780 KVA Wstgh. 2300 V. 185#, 15# Extraction

625 KVA Wstgh. 480 V. 250#, 25# Extraction

TURBINE UNITS
Noncondensing
3 phase 60 cycle

6250 KVA Allis 4600 V. 425#, 185# back pressure

625 KVA Allis 2300 V. 190#, 85# back pressure

625 KVA G.E. 240 V. 200#, 50# back pressure

625 KVA G.E. 2300 V. 200#, 10# back pressure

250 KVA Wstgh. 600 V. 150#, 15# back pressure

250 KVA Wstgh. 480 V. 300#, 30# back pressure

250 KVA G.E. 220 V. 240#, 5# back pressure

COMPLETE POWER PLANTS
3 phase 60 cycle

3125 KVA Wstgh. turbine unit 600 volts, 250#, 200 deg. sup. with surface condenser and pulverized coal fired boiler

1500 KVA (2-750 KVA) Skinner uniflow engine units, 2400 volts, 175#, 0 deg. sup. 15# B.P. with two stoker coal fired boilers.

UNIFLOW UNITS
3 phase 60 cycle

1000 KVA Skinner 2300 V. 125#

560 KVA Skinner 480 V. 150#

500 KVA Skinner 2300 V. 150#

400 KVA (2) Skinner Vert. 240/480 V. 150#

350 KVA Ames 2300 V. 150#

250 KVA (2) Ames Vert. 240 V. 160#

156 KVA Skinner 240 V. 150#

MOTOR GENERATORS
3 phase 60 cycle

300 KW (2) G.E. Syn. 275 volts D.C., 2300/4150 volts A.C.

150 KW Wstgh. Syn. 250 volts D.C., 4000 volts A.C.

ROTARY CONVERTERS
3 phase 60 cycle

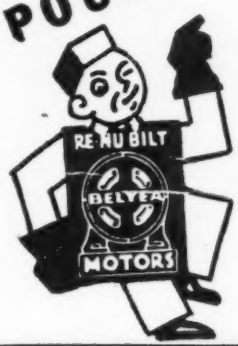
1500 KW Wstgh. 250 volts D.C., 2300 volts A.C.

1000 KW G.E. 600 volts D.C., 3300 volts A.C.

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. **Telephone: MAin 9514** **CLEVELAND 14, OHIO**

2 POINTS TO POUND ON!



① WE OWN WHAT WE ADVERTISE

WE SPEND OUR MONEY FIRST — SO

② IT HAS TO BE GOOD . . .

and Belyea "RE-NU-BILT" means

"SUCCESSFUL OPERATION GUARANTEED"

That's all you need to know, folks!

D. C. MOTORS

	HP	Make	Type	Volts	Speed
3—	800/1000	Whse.		450	600/720
1—	800	G.E.	MPC	660	600
1—	700	G.E.	MCF	600	150/525
1—	650	G.E.	MPC	250	115/145
1—	600	G.E.	MPC	600	650/900
2—	350	G.E.	MPC	220	450
1—	335	Whse.	MQ	250	300/900
1—	325	Whse.		230	1050/1250
1—	300	G.E.	DMC	230	400/600
1—	300	G.E.	MPC	230	275/550
2—	300	Cr. Wh.	CCM-151-H	230	630/700
1—	250	G.E.	MPC	230	400/500
1—	250	Al. Ch.		230	525
1—	150	G.E.	MPC	230	250/450
1—	130	Cr. Wh.	CMC-65H	550	1200
2—	125	G.E.	CO	230	625
1—	75/100	Rel.	1050T	230	400/1000
1—	100	G.E.	MPC	230	225/450
1—	75	Whse.	SK-180	125	650
1—	75	G.E.	C	230	500/1000
1—	75	G.E.	C	230	650/900
1—	60	El. Dy.	25-S	230	525/1050
2—	60	Whse.	Hoist	230	415
4—	50	Whse.	Hoist	230	400
2—	50	Cr. Wh.	65H	230	500/1000
5—	50-½ hr.	G.E.	MD-105B	230	550
1—	50	G.E.	RC-16	230	650
1—	50	Whse.	SK-160	230	565
1—	50	El. Dy.	50S	500	194/775
1—	50	Cr. Wh.	CMC-80H	230	380/750
1—	50	Cr. Wh.	CMC-81-H	230	300/900
1—	40	Whse.	SK-120	230	1700

TURBO GENERATOR SETS

1—500 KW Whse. 625 KVA. 440 V., 3 ph. 60 cy. 3600 RPM with Parsons' 145/175 lb. condensing turbine complete with jet condenser, and accessories.

1—300 KW. GE. 375 Kva. 2300 V. 3 ph. 60 cy. 3600 RPM with Form D-53-300 KW Turbine, 160-lb. pressure, non-condensing.

1—75 KW Ridgeway 250 V. D.C. with Terry 180 lb. pressure with 12 lbs. back pressure, 2000 RPM.

DYNAMOMETERS

1—100 HP Absorb. Block Test 250 V. 1050/4000 RPM GE type TLC-50.

1—100 HP. Absorb. Cradle Type 250 V.—1050/4000 RPM GE TLC-50.

15—35 HP-Absorb-Block Test-250 V. 825/2500 RPM GE-CD-105.

MOTOR GENERATORS SETS

3 ph. 60 cycle

1—1500 KW GE 275 V. d.c. to 2150 HP., 2200/4400 V. Syn. Motor with exciter.

1—500 KW. GE-600 V. d.c. to 700 HP-2300 V.

1—400 KW 3 unit with (2) 200 KW GE 125 V. D.C. gens. and 600 HP. 2300 V. Syn. Motor.

1—300 KW 3 unit with (2) 150 KW Cr. Wh. 125 V. D.C. gens. and 360 KVA 4000 V. Syn. Motor.

1—200 KW-GE 250 V. d.c. to 300 HP-440 V.

1—150 KW Whse. 600 V. d.c. to 225 HP. 2300 V.

1—150 KW Whse. 3 unit (2) 75 KW 125 V. gens. d.c. to 200 HP. 2300 V. Ind.

2—120 KW Whse. SK-151 B 250/275 V. d.c. to 200 HP. 2300 V. Ind. motor.

1—100 KW F.M. TRC-29—250 V. d.c. to 150 HP—220 V. Syn. Motor.

1—85 KW GE 250 V. DC to 150 HP 440 V. Sq. Cg. Motor.

1—75 KW GE 125 V. Gen. to 120 HP IK 4000/2300.

2—48 KW 3 unit with 2—24 KW GE 60 V. Gens. d.c. to 75 HP. 440 V. Ind. Motor.

1—50 KW GE 125 V. Gen. to 75 HP KT 4000/2300 V.

1—26.4 KW W.E. 38 V. Gen. d.c. to 41.5 HP 220 V.

1—19.8 KW W.E. 33 V. Gen. d.c. to 32 HP. 220 V.

SPECIAL
1—500 KW G.E. 250 V. M-G Set, 700 HP. 2300/4000 V. 3 ph. 25 cycle, with controls.

ROTARY CONVERTERS

60 Cycle

	KW	Make	Speed	D.C. Volt	Trans Volts
1—	1500	Whse.	720	600	2300
1—	1500	Whse.	600	600	11500
1—	1250	G.E.	720	250	2300
1—	1000	Whse.	900	600	11000
1—	750	Whse.	900	600	13200
1—	750	Whse.	720	250	6600/2300
1—	500	Whse.	1200	600	13200/2300

25 cycle

2—1500 G.E. 500 225/275 13200/6600

All units can be furnished with AC and DC Controls.

SPECIAL
1—2000 amp. 3 PST 15000 V. 250 V. Sal Operated Condit type F-120-15D OCB 1,000,000 Kva interrupting Capacity.

A. C. MOTORS

3 ph. 60 cycle

Synchronous

	HP	Make	Type	Volts	Speed
2—	2100	G.E.	ATI	2300/4600	514
1—	600	G.E.	TS	2300	900

Slip Ring

1—	2500	G.E.	MT	6600	253
1—	800	Al. Ch.		440	885
1—	600	Cr. Wh.	131-AQ	2300	507
1—	350	G.E.	MT-442y	4000/2300	257
1—	250	G.E.	MT	4000	257
1—	225	G.E.	IM	550	720
1—	200	Whse.	CW	2200	580
1—	75	F.M.	BY	2200	1750
1—	50	G.E.	MT-536	440	1150

Squirrel Cage

1—	725	G.E.	KT	13200/2300	590
1—	300	G.E.	IK-17B	2200	585
1—	250	G.E.	IK	440	600
1—	200	G.E.	IK	550	580
1—	200	G.E.	IK-17	440	580
1—	100	G.E.	IK-vert.	2300	450
3—	100	G.E.	K-6325Z	440	3600
1—	75	Al. Ch.		440	575

SYNCHRONOUS CONDENSERS

1—	5000	Whse.	2300/400	900
1—	3000	Al. Ch.	2300	900

D. C. GENERATORS

	KW	Make	Type	Volts	Speed
1—	1200	Al. Ch.	MHC	525	750
1—	500	G.E.	MPC	600	720
1—	200	Al. Ch.		250	580
2—	200	G.E.	CY-214	250/275	900
1—	150	G.E.	MPC	125	200
1—	150	Whse.	SK-151B	275	1200
2—	100	Whse		240	250

38TH YEAR OF SERVICE

WE OWN WHAT WE ADVERTISE

IT HAS TO BE GOOD!

BELYEA COMPANY, INC.

We Buy for Stock — for CASH
What Surplus Do You Have?

PHONE — JOURNAL SQUARE — 2-3334
Also
N. Y. CITY LINE — RECTOR 2-7150

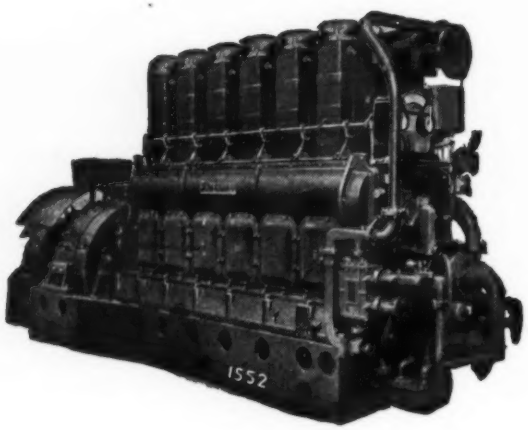
Main Office and Shop

43 HOWELL STREET

JERSEY CITY 6, N. J.

DIESEL GENERATORS

DIRECT CURRENT



4—250 KW Diesel Generators, Direct-Current, 120/240 volt, 3-wire

Each direct connected to

4—450 HP Enterprise, diesel engines, Type DSG-8, 450 RPM, 6 cylinder, 12" bore x 16" stroke

COMPLETE EQUIPMENT

BRAND NEW

OTHER DIRECT CURRENT OFFERINGS — IMMEDIATE DELIVERY

KW	VOLTS	MAKE	HP	MODEL	RPM	YEAR
3—500	120/240	General Motors	750	8-278-A	720	New
2—300	120/240	General Motors	450	6-278-A	750	New
6—275	120	Cooper Bessemer	440	FS-8	800	New
2—250	120/240	Enterprise	450	DSG-8	450	New
3—100	120/240	Superior	150	GDB-8	1200	New
1— 90	120	Winton	140	144	1200	1939
2— 60	120	General Motors	90	6-71	1200	1943
3— 15	120	Hill	30	4 C	1200	1940
2— 12	120	Hill	25	4 R	1200	1939
2— 10	120	Hill	20	4 R	1200	1940

WRITE—WIRE—PHONE

80,000 DIESEL HORSEPOWER FOR IMMEDIATE SHIPMENT

A. G. SCHOONMAKER COMPANY INC.

Established 1898

POWER CONSTRUCTION EQUIPMENT
DIESEL ENGINES

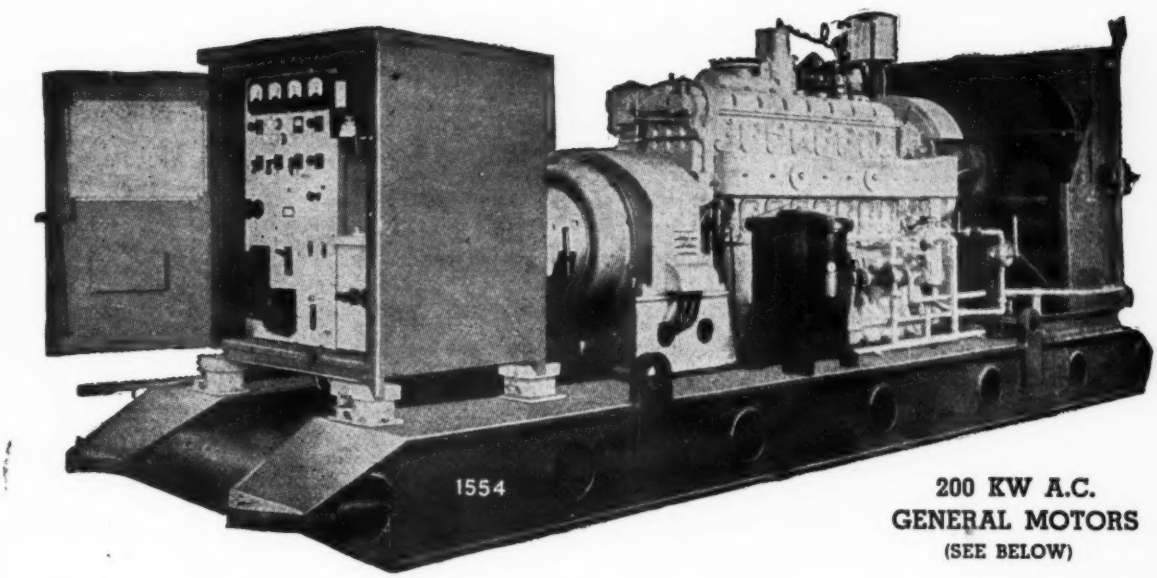
50 CHURCH ST., N. Y. 7, N. Y.

Phone WOrth 2-0455
Cable Address Agscomach.

DIESEL GENERATORS

ALTERNATING CURRENT

50 AND 60 CYCLES



200 KW A.C.
GENERAL MOTORS
(SEE BELOW)

OTHER IMPORTANT OFFERINGS FOR QUICK DELIVERY !!

KW	MAKE	H.P.	MODEL	RPM	YEAR
2—1500	Fairbanks Morse	2000	33E16	300	1939
1—1000	Nelseco	1500	6M1-53	300	1931
4—1000	General Motors	1600	16-287-A	720	1944
2— 800	General Motors	1200	16-278-A	600	1944
1— 500	Superior	750	OS	327	1938
2— 300	General Motors	450	6-278-A	600	New
1— 250	Enterprise	450	DSG-6	450	1945
1— 240	Fairbanks Morse	360	YVA	257	1928
*3— 200	General Motors	300	8-268-A	900	New
5— 200	General Motors	400	8-268-A	1200	1945
1— 125	Buckeye	190	70	514	1941
6— 100	General Motors	200	3-268-A	1200	1944
1— 75	Buckeye	112	E	400	1936
4— 60	General Motors	90	6061E	1200	New
13— 50	International	75	UD18	1200	New
8— 30	International	45	UD14	1200	New

80,000 DIESEL HORSEPOWER FOR IMMEDIATE SHIPMENT

WRITE FOR BULLETINS

A. G. SCHOONMAKER COMPANY INC.

Business Est. 1898

POWER CONSTRUCTION EQUIPMENT
DIESEL ENGINES

50 CHURCH ST., N. Y. 7, N. Y.

Phone WOrth 2-0455
Cable Address Agscomach.

FOR SALE—IMMEDIATE DELIVERY

POWER PLANT EQUIPMENT

TURBINE-GENERATOR UNITS

3 Phase, 60 Cycle

6250 KVA Allis non-condensing, 450 lbs. pressure, 725° TT, 185 lbs. exhaust 4500 volts, 3600 RPM.

2500 KVA Allis automatic extraction condensing, 200 to 300 lbs. pressure, 2300/600 volts, 3600 RPM equipped with direct connected exciter, condenser and switchboard.

2500 KVA G.E. condensing, 150 to 200 lbs. pressure, 2300 or 550 volts, 1800 RPM complete surface condenser, exciter and panel.

2500 KVA Westinghouse condensing, 180 lbs. pressure, 2300 volts, 3600 RPM, complete surface condenser, exciter, switchboard.

1875 KVA Westinghouse condensing, 175 to 200 lbs. pressure, 500° TT, 480 volts, 3600 RPM, complete with turbine driven exciter set, switchboard, Westinghouse jet condenser.

1563 KVA (2) G.E. automatic extraction condensing, 150 to 200 lbs. pressure, 480 volts, 3600 RPM equipped with direct connected shaft exciters, condensers, and switchboards.

1563 KVA G.E. non-condensing 150 to 200 lbs. pressure, 10 lbs. gauge back, 480 volts, 3600 RPM equipped with direct connected shaft exciter and switchboard.

1250 KVA Westinghouse Non-condensing, 200 to 250 lbs. pressure, 500° TT, 15 lbs. gauge back pressure, 480 volts, 3600 RPM, complete with exciter, switchboard panel.

1250 KVA Westinghouse condensing, 2400 volts, 3600 RPM, 200 lbs. pressure, equipped with direct connected shaft exciter, condenser, and switchboard.

940 KVA Westinghouse condensing, 150 lbs. pressure, 2400 volts, 3600 RPM equipped with exciter, surface condenser, switchboard.

938 KVA Allis Automatic Extraction condensing, 250 to 300 lbs. pressure, 500° TT, 2300 volts, 3600 RPM, complete surface condenser, exciter and switchboard.

375 KVA G.E. condensing, 150 to 200 lbs. pressure, 100° SH, 2300 volts, 3600 RPM, complete with surface condenser.

250 KVA G.E. non-condensing, 240 lbs. pressure, 5 lbs. gauge back, 220 volts, complete exciter and panel.

125 KVA Westinghouse non-condensing, 175 to 200 lbs. pressure, 0-10 lbs. gauge back, 240 volts with direct connected exciter and switchboard.

125 KVA G.E. non-condensing, 175 to 200 lbs. pressure, 10 lbs. gauge back, 2300 volts, 3600 RPM complete.

100 KVA Westinghouse non-condensing, 125 to 150 lbs. pressure, 10 lbs. gauge back, 2400/600 volts, 3600 RPM.

ENGINE-GENERATOR UNITS

3 Phase, 60 Cycle
Alternating Current

575 KVA General Electric, 460 volts, 150 RPM generator direct connected to 24" x 36" Nordberg Unaflow engine, 150 to 175 lbs. pressure, 10 to 40# back pressure.

500 KVA Westinghouse, 460 volts, 164 RPM generator direct connected to 26" x 28" Skinner Unaflow non-condensing engine, 140 to 160 lbs. pressure, 0 to 10-lbs. gauge back pressure. Complete installation.

500 KVA G.E. 2300 volt generator direct connected to Chuse Unaflow engine.

312 KVA Elliott, 4000/2300/550 or 240 volts, 180 RPM generator, direct connected to a 17" x 24" Elliott Unaflow non-condensing engine, 175 lbs. pressure, 6 lbs. back pressure.

300 KVA G.E. 2300/480/240 volts, 200 RPM generator direct connected to Skinner Unaflow non-condensing engine—Complete.

225 KVA E. M. 2300 volts, 200 RPM generator direct connected 19" x 24" Chuse Unaflow poppet valve engine.

200 KVA Crocker-Wheeler, 240 volts, 400 RPM generator direct connected to Ames vertical Unaflow engine, 110 to 125 lbs. pressure, 5 lbs. gauge back.

150 KVA G.E. 240 volts, 225 RPM generator direct connected to Ames Unaflow engine.

75 KVA Allis 2300/550 or 440 volt, 257 RPM generator direct connected to 12" x 16" Chuse 4 valve non-releasing Corliss engine.

ENGINE-GENERATOR UNITS

Direct Current

300 KW Allis-Chalmers, 250 volts, 150 RPM generator direct connected to 24" x 28" Chuse Unaflow non-condensing engine, 130 to 150 lbs.

125 KW, 125 volts, 250 RPM generator direct connected to 18" x 16" Elliott engine, 100 lbs. pressure, 10 lbs. back pressure, complete with switchboard.

75 KW Westinghouse, 125 volt, 1800 RPM non-condensing turbine genrator.

75 KW Allis-Chalmers Terry, 125 volts, 2400 RPM non-condensing turbine-generator unit.

15 KW (2) Crocker-Wheeler, 125 volts, 410 RPM generators each direct connected to an American Blower vertical engine.

SPECIAL OFFERINGS

125 KVA (4), 3 phase, 60 cycle, 480 volts, 514 RPM Electric Machinery horizontal synchronous generators. NEW.

300 HP, 6 cylinder, style VA, 257 RPM Fairbanks-Morse vertical full Diesel engine direct connected to a 200 KW 80% P.F.—240 KVA, 3 phase, 60 cycle, 2300 volts, 257 RPM Fairbanks Morse alternating current generator.

500 KVA Westinghouse, 3 phase, 60 cycle, 600 volts, 514 RPM belted generator.

750 KVA Westinghouse, 3 phase, 60 cycle, 2300 volts alternating current generator, direct connected to 910 HP, 3 phase, 25 cycle, 2300 volts, 300 RPM synchronous motor.

1000 KW, 265 volt direct current—6 phase, 60 cycle, 514 RPM Westinghouse booster type rotary converter complete with transformers.

1200 KVA General Electric, 3 phase, 60 cycle, 2400 volts alternating current generator direct connected to 1700 HP, 3 phase, 25 cycle, 2300 volts, 300 RPM synchronous motor.

3480 sq. ft. Allis surface condenser.

6000 sq. ft. C. H., Wheeler surface condenser.

10 Ton Brown Hoist hand-operated crane with 31' 0" span, approximately 150 ft. 15" I-beam with 6" wide flange.

2—10 Ton Yale Spur Geared Chain Block Hoists.

1—ALLIS-CHALMERS SYNCHRONOUS MOTOR GENERATOR SET CONSISTING OF: 1500 KW 550/600 volts, 300 RPM compound wound interpole direct current generator direct connected to a 2190 HP, 3 phase, 60 cycle, 4000 volt, 300 RPM, A.C. motor.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG.
CLEVELAND 14, OHIO

WIRE OR PHONE
LONG DISTANCE 422

Dependable Rebuilt Electrical Equipment

1 YEAR GUARANTEE

3 Ph. Squirrel Cage Motors

Qu.	H.P.	Make		Speed
2	150	Howell	BB	1750
1	147	West.	25 cyc.	715
1	60	Burke		690
1	50	West.	CCL	1150
1	50	Cr. Wh.	1220	1150
1	50	West.	CS	580
1	50	G.E.	KT	580
1	50	G.E.	I-14	495
1	40	Triumph	TR	690
1	35	Wagner		850
1	30	U.S.	Vert.	3450
1	30	Cr. Wh.		870
1	30	Watson		850
1	30	West.	CCL	690
1	25	Wagner	Fy. Welch.	1200
1	25	Wagner	Vert.	1160
1	25	G.E.	IK	870
2-20/10		West.	XP	1160/580
1-20/10		West.	XP	885/440
1	20	G.E.	KT-312	1700
1	20	G.E.	Vert.	1750
1	20	R & M	K-207	1160
1	20	G.E.	Vert.	1175
1	20	Al. Ch.		870
1	15	Wagner	Fy. Welch.	1800
1	15	G.E.	KT-312	1150
1	15	Howell		1150
1	15	Al. Ch.		1150
1	15	G.E.	Vert.	1150
1	15	Lincoln		1150
	15	West.	MS	1150
1	15	G.E.	Vert.	870
1	15	Wagner	15VPR	860
1	15	Wagner	Fy. Welch.	720
1	15	West.	CS-504	415

2 Ph. Squirrel Cage Motors

Qu.	H.P.	Make		Speed
1	50	Lincoln	C-15	870
1	50	G.E.	IQ	870
1	40	Al. Ch		870
1	30	West.	CCL	1150
1	25	Burke]		870
3	25	G.E.	IQL	1150
1	25	West.	CCL	1150
1	15	G.E.	KQ-502	1150
1	15	West.	CS	1155
1	15	Al. Ch.		1130
1	15	West.	CS-572	860
1	15	G.E.	IQ	690

A.C. Slip Ring Motors

Qu.	H.P.	Make	Type	Speed
1	200	G.E.		1200
1	112	G.E.	ITC	720
1	75	West.	CW	600
1	75	Al. Ch.	Hoist	575
1	64	G.E.	MTO-552	585
1	50	G.E.	MT 2300 V.	600
1	52	G.E.	ITC	860
1	50	Al. Ch.		865
1	50	G.E.	MT-342	860
1	40	West.	HF	850
1	40	G.E.	MT 2300 V.	570
1	35	Al. Ch.		870
1	30	G.E.	ITC	1200
1	30	G.E.	MQ-332	870
1	30	West.	CI-574A	870
4	30	West.	CI-582C	870
2	30	G.E.	MT-542	690
1	25	Al. Ch.		870
1	25	Howell	SRS-420	870
1	25	G.E.	1M	565
1	20	West.	CW	870
1	15	West.	CW	870
1	15	G.E.	MT-512	845
1	15	Al. Ch.		680
1	15	G.E.	MQ-332	670

A.C. Generators

Qu.	K.W.	Make	Voltage	Speed
1	150	G.E.	220/440	1200
1	150	G.E.	240/480	600
1	133	West.	G	1200
1	106	El-Mchy	208/120	1200
1	100	West.	240/480	600
2	30	Century	208/120	1200

230 Volt D.C. Motors

Qu.	H.P.	Make	Type	Speed
1	350	West.	SK	340/425
1	125	West.	SK190	600
1	100	West.	SK180	625
1	75	West.	SK180	475
5	60	West.	SK160	680
1	60	G.E.	C-Inter.	480/1100
1	50	G.E.	RC-19	400/1200
1	45	Diehl	K-10	850
1	40	G.E.	DLC	1050
2	35	West.	SK-120	1150
1	35	G.E.	RLC-204	440/800
2	35	West.	SK-160	400/600
1	30	G.E.	RC-32]	1100
1	30	West.	SA	500/1500
1	25	G.E.	RC-31	1150
1	25	West.	SK	1100
1	25	Reliance	92T	1150
1	25	Al. Ch.		850
1	25	Rel.	MS	500/1500
1	25	G.E.	RF	400/1200
3	20	G.E.	RF	500/1500
1	20	G.E.	RF	400/1200
1	20	G.E.	CD-83	1200
1	20	R. & M.		1160
1	20	El. Dyn.	7½-S	950
1	20	West.	Hoist	700
1	15	Rochester		3450
1	15	West.	SK-83	1150
2	15	G.E.	RC	1150
1	15	G.E.	CD-Vert.	900
1	15	G.E.	CD-85	850
2	15	G.E.	RC-30	850
1	15	Reliance	T155	400/1600
1	15	Sprague	D	700
1	15	West.	SK	675/1350
1	15	West.	SK-100L	600/2500
2	15	West.	SK	500/1500
1	9	L-A	Baler	1750
4	10	G.E.	RC	1150
2	10	G.E.	CD-75	1150
1	10	Diehl		900
1	10	G.E.	RC	29/850
1	10	G.E.	CD-83	850
1	10	Roth		800
1	10	Diehl	LS-14	750
1	10	West.	Elevator	700
1	10	G.E.	CVC	700
1	10	West.	SK	600/1200
1	10	G.E.	RLC	500/1500
1	10	West.	SK	500/1500
1	10	El. Dyn.		450/1800
2	10	West.	SA	400/1200
1	10	West.	SK-90	400/1200
1	10	Diehl		200/247
1	7½	Sturt.	TF	3600
1	7½	El. Dyn.	2S	1750
1	7½	G.E.	RC	1150
6	7½	West.	SK-40	1180
1	7½	G.E.	CO-1804	
1	8	L-A	Baler	1200
2	7½	West.	SK	850
2	7½	G.E.	RC	850
1	7½	West.	SK-60	850
2	7½	G.E.	RF-9	600/1800
1	7½	G.E.	RF-10A	600/1500
1	7½	West.	SK-90	650/1300
1	7½	El. Dyn.	3S	550/1650
1	7½	G.E.	RF-10	450/1800
1	7½	G.E.	RF-10	450/1600
1	7½	G.E.	RF	450/1800
2	7½	West.	SK-70	400/1600
1	7½	Al. Ch.		350/1050
1	7½	L-A	Baler	

110 Volt D.C. Motors

Qu.	H.P.	Make	Type	Speed
1	45	G.E.	RC	1100
1	20	G.E.	CD83	1750
1	20	G.E.	CD95	1150
2	10	Lincoln	I-SC	3500
1	10	E. Dyn.	3S	1100
1	10	West.	SK-70	1150
1	10	G.E.	CD73	1150
1	10	Reliance		400/1600
2	10	Diehl		230
1	7½	G.E.	CVC	725
1	7½	El. Dyn.	5S	450/900
1	7	El. Dyn.		600/1200

D.C. Generators

KW.	Make	Voltage	Ampere	Speed
300	Burke	250/125	1200	900
300	West.	250	1200	900
250	G.E.	125	2000	720
200	Cr. Wh.	550	363	900
100	G.E.	125	800	1150
100	Cr. Wh. (2)	125	800	1200
100	Al. Ch.	250/125	400	1150
75	Cr. Wh. (2)	125	600	1200
50	G.E. (2)	125	400	1150
50	G.E.	250	200	870
30	El. Dyn.	600	50	1150
30	G.E.	250	120	1750
30	G.E.	125	240	1150
25	G.E.	125	200	1150
20	West.	250	100	1150
10	West.	250	40	1150
10	West.	125	80	1150
7½	G.E.	250	30	1150
7½	West.	125	60	1150

AIR COMPRESSORS

12½"x12"	American
10"x6"	Gardner
9"x8"	Ingersoll Rand
9"x8"	Sullivan

LEEDS & NORTHRUP MICROMAX

INDICATING THERMOCOUPLE PYROMETERS

Model S Recorders
Model C Controllers
Model R Recorders

Some New—
All Others Equal to New

THIS IS A PARTIAL LIST ONLY!

L. J. LAND & COMPANY

146 GRAND STREET, NEW YORK 13, NEW YORK

Established 1910

CAnal 6-6976

New England Representative
BOSTON, MASS., 411 Atlantic Ave.,
Phone: Liberty 4300

Branch:
READING, PENNA., 10th & Exeter Sts.
Phone: Reading 2-6866

SIX AIR COMPRESSORS

Available For Immediate Shipment

WORTHINGTON AIR COMPRESSORS

4—1858 CFM Worthington Air Compressors, Type DC-2, size 23 x 14 x 14, 2-stage horizontal, 100# pressure, 277 RPM with air filters, inter-coolers and after-coolers. Direct connected to 300 H.P., General Electric Synchronous motor, 3 phase, 60 cycle, 2300 volt, 277 RPM, .8PF, complete with 5-step control and 5 KW MG set for excitation, 3 phase, 60 cycle, 440 volt input, 125 volt DC output with starter and control panel. *Purchased new March, 1943. In excellent condition.*

2—54" x 14" Air Receivers, ASME Code, 125# pressure.

1—66" x 18' Air Receiver, ASME Code, 125# pressure.

SCHRAMM AIR COMPRESSORS

1—Schramm gas driven air compressor. Displacement 315 CFM, at a working pressure of 100#. Portable mounted on pneumatic tires with a spare set of steel wheels complete and self-contained. *Purchased in 1945.*

1—Schramm gas driven air compressor. Displacement 210 CFM, at a working pressure of 100#. Portable mounted on pneumatic tires with a spare set of steel wheels complete and self-contained. *Purchased in 1945.*

TURBO-GENERATORS — MOTORS — WELDERS

GASOLINE DRIVEN POWER PLANT

1—35 KVA gasoline driven power plant, Hercules Motor Corp. engine, 4¼x4¾, Model WXLC-3, Serial #180572, with U. S. Motors Generator, Type M-7, 220 volt, 3 phase, 60 cycle, 1200 RPM, Serial #2981, complete self-contained with panelboard.
Has a center tap, 110 volts, single phase.

1—5000 KW Westinghouse Turbo-Generator, 3600 RPM, 200# pressure, condensing, 2300/3/60 complete

1—710 HP Terry Turbine, 3600 RPM, 145# ISP, 0-60# BP, 18" x 18" centrifugal pump, rated 13,000 GPM, 170' head, 1000 RPM

1—KW Westinghouse Turbo-Generator, 200# pressure, 75 HP, 7200 RPM, geared to 50 KW, 125 V DC 1200

1—800 KW Westinghouse M-G set, Synchronous Motor, 1150 HP, 514 RPM, 13200/60/3. Generator 250 V DC with direct connected exciter

1—300 KVA Generator Set, Burke Alternator, 480/60/3, 200 RPM, direct connected to exciter and Skinner Uniflow, 150# ISP, O-5# BP

1—1000 H.P. General Electric Slip Ring Motor, 6600/60/3, 600 RPM, with controls

1—700 H.P. General Electric, Type KF motor, 2300/60/3 1800 RPM

1—150 KW General Electric Alternator, Type ATB, Form B, .8 PF, 480/60/3 600 RPM, 3 bearing, direct connected exciter

300 and 400 Ampere

MOTOR DRIVEN ARC WELDERS

General Electric—Hobart—Lincoln
New 1943 — Reconditioned
Used less than 1 yr.

CARRIER AIR CONDITIONING UNIT

1—25-ton Carrier Air-Conditioning Unit, Complete including Kuthabar unit. Installed new in 1944. Used one season

MISCELLANEOUS

1—3600 sq. ft. CR. Wheeler Surface Condenser

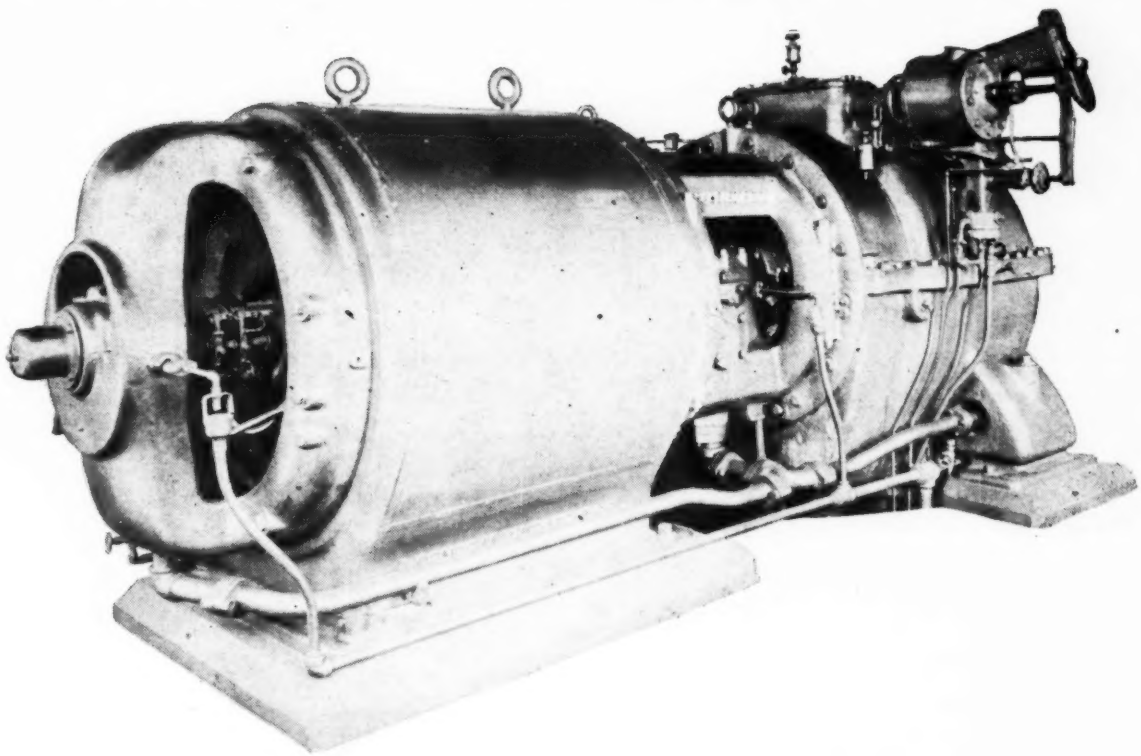
2—12" LeCourtney Centrifugal bronze fitted pumps, 1800 RPM

1—20-ton Box Crane, hand operated, 39 ft. span, complete ½, ¾, 1, 1½ and 2 ton Chain Hoists, standard Lift ½, 1 and 1½ ton Electric Hoists, 3 ph. 60 cyc. 220/440 volt

Heat and Power Co., inc.

70 PINE STREET | WHITEHALL 3-2172 | NEW YORK 5, N. Y.

TURBO-GENERATORS



A Partial List of Our Stock Is Noted Below

20000—KVA-West. Surf.Cond. 250/400# 2300-V

2—1565 KVA. G.E. Aut. Ext. 30# 200# ISP. 3/60/480-V

6250—KVA-G.E. Surf.Cond. 200# 2300-V

6250—KVA-A-C. Non.Cond. 425# 185#BP

3750—KVA-G.E. Surf.Cond. 200# 2300-V

2500—KVA-G.E. Surf.Cond. 200# 2300-V

2500—KVA. G.E., Non-Cond. 30#-BP. 200 PSI., 480-2300-V

2500—KVA. West. 200#-PSI, 2300-V. Sur. Cond.

2500—KVA, Allis-C., Cond. Aut. Ext. 30#, 200# PSI., 2300-V.

937—KVA. Murray-Allis Aut.-Ext. 30#: 300# PSI 2300-V.

1875—KVA-G.E. Cond'sing. 200# 2300-V

1565—KVA-G.E. Surf.Cond. 150# 2300-V

1250—KVA-A-C Non-Cond 150# 480-V

1250—KVA-West. Surf.Cond. 200# 2300-V

937—KVA-A-C Condens'g 480-V

Also Specialists in Diesel Engines, Boilers & Genl. Power Plant Eqpt.

WE OWN and CAN SHIP FROM STOCK

450-HP Baldwin Diesel Engines **320-HP Atlas Imperial Diesel Engines**

Also Any Other Size or Capacity Diesel Engine Desired

WRITE OR WIRE US

CHARLES WEAVER & COMPANY

4045 Penobscot Building—Telephone Cadillac 1340-1

DETROIT, MICH.

NEW DIESEL GENERATOR SETS

IMMEDIATE DELIVERIES—STRICTLY SUBJECT TO PRIOR SALE

This material is all in stock for immediate shipment as this list is printed; however this type of material is in very big demand and it is recommended that any interested buyers wire their orders for any quantities that they may want and we will hold for their confirmation. Prices in each case cover the units, F.O.B. Philadelphia, boxed for ocean shipment.

6—60 KW (75 KVA) General Electric AC Generators 3 phase 50/60 cycle 127/230 volt 4 wire 1000/1200 RPM with direct connected exciters and with direct connected 120 HP General Motors Model 6-71 full diesel 1000/1200 RPM diesel engines. Units include radiator for cooling, electric starting batteries and switchboards with automatic voltage regulators. Approximate Shipping Weight 7500#. Price each.....$6000.00

3—5 KVA Witte Diesel Electric Power Plants Type HD-24 110/220 volt single phase 60 cycle consisting of horizontal single cylinder Witte diesel engine 850 RPM on common base with V-belt driven generator and exciter. This is a standard set including fuel tank fuel pump fuel and oil filters air cleaner and silencer thermo-syphon system for cooling. Price each $1100.00

2—30 KW Century 3 phase 60 cycle 127/220 volt A.C. 1200 RPM Generator with direct connected International Model UD14 54 HP 1200 RPM diesel engine with radiator starting batteries and all trim. Rebuilt and guaranteed. Price .....$3350.00 ea.

1—30 KW Century Electric Generator same as above but with direct connected 55 HP Buda 1200 RPM diesel engine with same trim. Rebuilt and guaranteed. Price $3350.00

6—New 15/20 HP Hill Model 2R diesel power units 1500/1800 RPM with twin disc clutch radiator starting battery Bosch fuel system. Price..$1200.00 ea.

10—100 KW Westinghouse 3 phase 60 cycle 220/440 volt 1200 RPM Generators with exciters, direct connected to 150 HP General Motors Model 3-268A 3-cylinder 1200 RPM diesel engines with Marquette governor and standard trimmings. Circulating cooling water pump included. Air starting type units, new 1943, slightly used, offered rebuilt guaranteed at...$7500.00 ea.

10—200 KW Westinghouse A.C. Generators 3 phase 60 cycle 220/440 volt 1200 RPM with direct connected 125 volt D.C. Auxiliary Generator and exciter all on common base and direct connected to 350 HP General Motors Model 8-268A 8-cylinder 1200 RPM diesel engine with standard trim including cooling water circulating pump arranged for air starting. Units new 1943, slightly used, offered rebuilt, guaranteed at...$1200.00 ea.

AIR COMPRESSORS

CFM	Horizontal SIZE	Straight Line MAKE	V Belt Driven TYPE	PRESSURE
55	5x 5	INGERSOLL-RAND	ER	150#
67	6x 6	CHICAGO PNEUMATIC	NSB	150#
67	6x 6	INGERSOLL-RAND	ER	150#
92	7x 6	INGERSOLL-RAND	ER	100#
153	9x 6	INGERSOLL-RAND	ER	40#
311	12x 8	CHICAGO PNEUMATIC	NSB	45#
350	12x 9	WORTHINGTON		40#
379	12x 7	WORTHINGTON		20#
368	12x10	SULLIVAN	WG6	100#
368	12x10	INGERSOLL-RAND	ER	100#
386	12x12	CHICAGO PNEUMATIC	NSB	115#
		Vertical		
120	5½x5	CURTIS	C	100#
68	554	INGERSOLL-RAND	30	150#
		Steam Driven		
92	7x 7x 6	INGERSOLL-RAND		100# (Air)
136	8x 8x 8	CHICAGO PNEUMATIC		130# (Air)
235	12x12x12	AMERICAN		100# (Air)
350	10x11x12	WORTHINGTON		125# (Air)

NEW RED LINE STANDARD MILL EXHAUSTERS

All equipped with Ball Bearing; V-belt Drive Extra, if Desired.

Size	Inlet	Size	Inlet
25	9⅜"	40	15⅛"
30	11½"	50	18⅛"
35	13⅜"	45	17"

MOTOR GENERATOR SETS

1—100 KW General Electric 250 volt compound interpole with 150 HP General Electric synchronous motor, 3 phase, 60 cycle, 480 volts including exciter and panels.

1—40 KW Westinghouse 150 volt shunt 1200 rpm with 60 HP Westinghouse synchronous motor, 3 phase, 60 cycle, 220/440 volt.

1—40 KW General Electric 125 volt compound interpole with 60 HP General Electric squirrel cage, 3 phase, 60 cycle, 2300 volt, 1200 rpm motor.

2—15 HP Fairbanks-Morse horizontal single cylinder Type "Y" Style "H" Diesel Engine 400 RPM with 30" x 13" belt wheel and 2-48" diameter by 2½" flywheels. Boxed for export. Cubic measurement of box—134 cu. ft. Shipping weight approximately 2100 kilos. Price rebuilt guaranteed with standard equipment, boxed for export.....$1000.00 ea.

5—100 KW, 125 KVA, Electric Machinery Company A.C. Generators, 3 phase, 60 cycle, 220/110 volt, 3 phase, 50 cycle, 230/400 volt, direct connected to Hercules diesel engine with radiator, switchboard, starting batteries, voltage regulator .....$3500.00 ea.

20—75 HP Chrysler Diesel Power Units, Model IND, 6 cyl., 1800 RPM, including set 4 batteries, fuel tank, radiator and housing fabricated steel base, silencer and kit of tools with each unit.....$2200.00 ea.

6—8 HP Sheppard Model 7A diesel standard power units with radiator cooling, fuel supply base, 24 volt Electric Starting and power take-off clutch including batteries and cables.....$1066.00 ea.

2—16 HP Sheppard Model 13 2-cylinder 1200 RPM diesel power units with radiator cooling, fuel supply base, 24 volt Electric Starting and power take-off clutch including batteries and cables.....$1314.00 ea.

2—25 HP Sheppard Model 6A-1 3-cylinder diesel power units, 1200 RPM, with radiator cooling, fuel supply base, 24 volt Electric Starting and power take-off clutch including batteries and cable.....$1648.00 ea.

2—Model 7A Sheppard diesel engines with radiator cooling direct connected thru a Thomas Flexible Coupling to a Fidelity 5 KW 110/220 volt, 60 cycle, A.C. single phase generator with rheostat including batteries and cables .....$1687.00 ea.

3—Model 13 Sheppard Diesel Engine with rad. cooling direct connected by a Thomas Flexible Coupling to a Fidelity 10 KW 110/220 volt 60 cycle three phase A.C. Generator with rheostat mounted on steel H Beam Base including batteries and cable .....$2080.00 ea.

SQUIRREL CAGE MOTORS
3 PHASE, 60 CYCLES, 220 or 440 VOLTS

NO.	HP	MAKE	TYPE	RPM
1	15	G.E.	KT	565
2	20	G.E.	K	850
1	25	Allis Chalmers	AR	686
1	25	G.E.	KT	1750–Vertical
1	30	G.E.	KT	1735
1	30	U.S.	TEFC	900 (new)
1	30	G.E.	KT	865 (550v.)
1	35	G.E.	IK	600
1	35	G.E.	IK	720
4	40	Howell	Linestart	900
3	50	Howell	Dripproof	900
5	50	Howell	TEFC	514
1	100	G.E.	IK	600
1	125	West.	CS	870
1	150	G.E.	IK	850
2	150	Howell	Linestart	1800
1	200	West.	CS	580
1	200	Allis Chalmers	ART (3 bearing)	900 (2300v. new)
4	200	Wagner	RP2	1800 (new)

SLIP RING MOTORS
3 PHASE, 60 CYCLES, 220 or 440 VOLTS

NO.	HP	MAKE	TYPE	RPM
1	25	Burke	EMV	1720
1	35	G.E.	IM	850
2	50	West.	CW	1200
1	60	G.E.	TS	1200 synchronous
1	75	G.E.	UTC	860 D. E. Shaft
1	125	West.	CW	900
1	800	G.E.	MT	450
1	1000	G.E.	IM	400

A. C. GENERATORS

NO.	KVA	MAKE	TYPE	RPM
1	62½	West.		1200 (2 phase)
1	150	Wagner (3 bearing)	BF	600 (2 phase)
1	187½	G.E. (3 bearing)	ATB	600

New Motors scheduled for delivery this fall 1 to 100 HP all speeds.

OPEN TEFC EXPLOSION PROOF

WIRE ORDERS NOW!

THE O'BRIEN MACHINERY CO.

T.M. REGISTERED U.S. PATENT OFFICE

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PHILADELPHIA'S LARGEST MACHINERY DEALERS AND EXPORTERS

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SOC EXPANSÃO INDUSTRIAL SUL AMERICANA LTDA

RIO DE JANEIRO — BRASIL

THESE ARE ALL SOUND UNITS

WE CAN RECOMMEND INSPECTION

TURBO ALTERNATORS

CONDENSING

300 KW 240 V 150# 100° Surf Cond (new 1929) factory rebuilt
500 KW 2400 V 150# 100° Surf Cond (new 1919)
500/750 KW several other good units available
1000 KW (3 units) 2400 V 150# 100° Jet Cond (new about 1922)
1000 KW 2400 V 200# 100° Surf Cond (new 1925)
1250 KW 2400 V 200# 100° Surf Cond (new 1924)
1500 KW 480 V 200# 100° Jet Cond (new 1920)
2000 KW 600 V 200# 100° Jet Cond (new 1920)
2500 KW 2400 V 200# 100° Jet Cond (new 1922)
3000 KW 600 V 200# 100° Surf Cond (new 1931)
5000 KW 2400 V 175# 100° Jet Cond (new 1920)
7500 KW 2400 V 175# 100° Surf Cond (new 1919)
12500 KW 6900 V 200# 100° Surf Cond (new 1924)

EXTRACTION—CONDENSING

1000 KW 2400 V 175# 100° ISP Automatic Control 5 to 15# g. Extr.
1250 KW 480 V 175# 100° ISP Automatic Control 5 to 15# g. Extr.

EXTRACTION NON-CONDENSING

750 KW 480 V 175# 100° ISP; 75# g. Extr. Automatic Control; 100# g. BP

NON-CONDENSING

100 KW 240 V 175# 100° ISP 0 to 5# g. BP (new 1921)
200 KW 600 V 200# ISP 0# BP (new 1924)
500 KW 480 V 175# 100° ISP 5 to 20# g. BP (new 1920)
2000 KW 2400 V 175# 100° ISP 5 to 15# g. BP Rebuilt

PLANT COMPLETE

3000 KW 480 V 400# 650° ISP; approx. 110,000# process steam at 50 # g.

DC TURBO UNITS

750 KW 250 V 16#/165# (M.P.) Jet Condenser
150 KW (2 units) 250 V 225# 25# g. BP modern design

ENGINE GENERATORS

60 cycle 3 phase

168 KW 2400 V Ames Uniflow 150# with auxiliaries (new 1930)
190 KW 480 V Skinner Counterflow 150# with auxiliaries, good condition
200 KW 2400 V Ridgeway Uniflow 150# with auxiliaries (new 1926)
300 KW 208 V Y Skinner Uniflow 150# complete (new 1929)
450 KW 480 V Skinner Uniflow 150# ISP 0 to 20# g. BP (new 1922)
400 KW 480 V Allis Corliss 175# 150° ISP 25# (new 1924), excellent unit
500 KW 480 V Chuse vertical Uniflow 150# complete
600 KW 2400 V Chuse Uniflow 200# C or NC (new 1922)
800 KW 2400 V Skinner Uniflow 200# (new 1930) good unit

DC ENGINE SETS

200 KW (2 units) 250 V DC Hamilton Corliss left hand
600 KW 250 V DC 3-wire Skinner Vertical Uniflow 150# ISP 3" g. BP (new 1931) good condition

BOILERS

WATER TUBE

250 HP (3 units) 200# Stokers B&W Stirling (new 1921)
300 HP (5 units) 150# Grates for sawmill refuse. Wickes vertical
365 HP (2 units) 200# 100° Stokers Edgemoor str tube (new 1923)
550 HP (2 units) 165# 100° Oil fired Heine str tube (new 1922)
600 HP 200# B&W Stirling (new 1922)
1000 HP (2 units) 225# oil firing B&W Stirling (new 1925)
650 HP 400# 2-drum vertical bent tube (new 1930)

FIRE TUBE

90 HP 118# stoker equipped ASME Mich. Code HRT
190 HP 125# stoker equipped ASME Ohio Code HRT
200 HP (2 units) 115# stoker equipped ASME Code HRT
250 HP 125# grates and stack non-code Scotch Marine
100 HP (4 units) 200# oil firing Drilling boilers fire box type

DIESEL ENGINE GENERATORS

60 cycle 3 phase

400 KW/600 HP 480 V Clark 2 cycle vertical 400 RPM
375 KW/560 HP 2400 V Fairbanks Model 33, 257 RPM
540 KW/800 HP 480 V 4 cycle 6 cylinder 360 RPM new units
465 KW/700 HP 2400 V Fairbanks Model 33, 257 RPM
500 KW/740 HP 480 V Alco 514 RPM
250 KW/375 HP 240 V Alco 5 cylinder 360 RPM (new 1938)

250 V DC UNIT

200 KW/300 HP 250 V Worthington 327 RPM (new 1933)

POWER UNITS

180 HP Fairbanks Morse Model 32E12 (new unit)
225 HP Buckeye 6 cylinder 400 RPM complete (new 1931)

MOTOR GENERATORS

190 KW: 60/3/440 Synchronous, 25/80 V DC with exciters, panel, controls
500 KW: 60/3/4000 Synchronous, 250 V DC, all accessories
1500 KW: 60/3/2200 Synchronous, 250 V DC, with exciters, rheostats
3500 KW: 60/3/13200 Synchronous, 250 V DC, with exciters

ROTARY CONVERTERS

1000 KW: 60/6/13200 AC, 250# V# DC, with transformers

ARC RECTIFIERS

1000 KVA (2 units) 600 V DC Brown-Boveri. Specs available

FREQUENCY CHANGERS

500 KW 60/3/4160 Y—25/3/4160 Y needs reconditioning
1000 KVA (2 units) 60/3/2400—40/3/10,000 complete
1500 KW (2 units) 60/3/4160 Y—25/3/6900 Y complete start either end

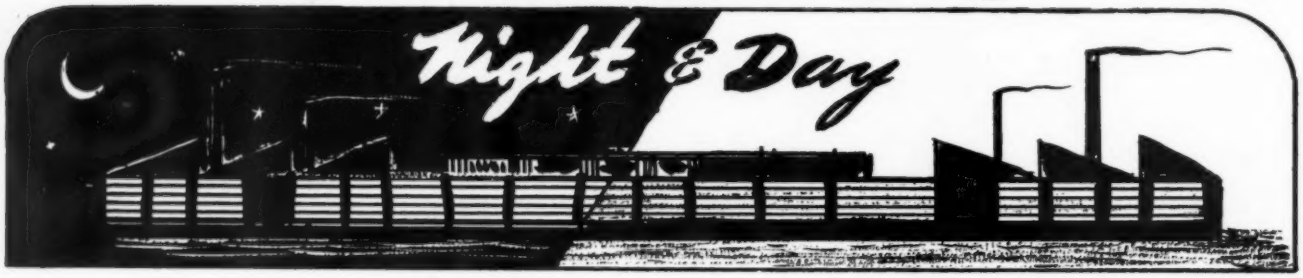
TRANSFORMERS

100 KVA to 4000 KVA 69, 44, 33, 22, 13.2, 2.4 KV primaries

PAUL STEWART & CO., INC.

UNION TRUST BUILDING . . CINCINNATI 2, OHIO

Over 50 Years of Service



Our NEW MOTORS give top notch performances every time

INVENTORY OF GEAR HEADS

Quantity	H.P.	R.P.M.	Quantity	H.P.	R.P.M.	Quantity	H.P.	R.P.M.
3	1/2	30	1	1	190	8	3	39
2	1/2	45	3	1	350	3	3	45
2	1/2	190	1	1 1/2	39	2	3	68
7	1	59	2	1 1/2	45	1	3	99.2
2	1	68	3	1 1/2	110	90	1/15	172
2	1	88	2	1 1 2	151	1	60 Sq. Cage	116
1	1	125	2	2	68	3	40 Slip	85
1	1	155	4	3	30	1	3	80
						22	3 4	148

NEW STANDARD OPEN SQUIRREL CAGE 3/60/220-440 B.B. NEW

Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M
7	20	404	1200	2	50	445	1800	2	100	5084	1200
16	25	365	1800	4	50	504	1200	1	125	5085	1800
10	25	404	1200	1	60	504	1800	3	125	6085	1200
6	30	405	1800	1	60	505	1200	1	150	5085	1800
9	30	444	1200	1	75	505	1800	4	150	6085	1200
6	40	444	1800	6	75	5084	1200	2	200	6085	1800
3	40	445	1200	4	100	5084	1800	2	200	6085	1200

NEW TOTALLY ENCLOSED FAN COOLED 3/60/220-440 B.B. NEW

Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.
10	20	404	1200	2	40	445	1200	4	75	508	1200
14	25	365	1800	6	50	445	1800	3	100	508	1800
20	25	405	1200	4	50	504	1200	2	100	508	1200
1	30	405	1800	5	60	504	1800	2	125	6085	1800
3	30	444	1200	3	60	605	1200	2	125	6085	1200
4	40	444	1800	3	75	505	1800	2	150	6085	1800
								2	150	6085	1200

NEW 40 H.P. AND LARGER, NEMA FRAME NEW

200 HP	A&C	Type Art Sqc	2300 V	900 RPM	6— 40 HP		Type TEFC	440 V	900 RPM
300 HP	West	Type CS Sqc	220C V	587 RPM	250 HP	AC	Type ABN	440 V	900 RPM
3—200 HP	Wag	Type RP2 Sqc	440 V	1800 RPM	200 HP	GE		440 V	900 RPM
9—150 HP	Howell	Type Sqc	440 V	1800 RPM	200 HP	GE		440 V	720 RPM Reb
125 HP	GE	Type 1M Slip	440 V	720 RPM Reb	100 HP	W	Type CS	440 V	900 RPM Reb
9— 50 HP		Type TEFC	440 V	514 RPM					

50—3 HP GE 115 V Only

Capacitor 1750 RPM single phase 60 cycle

150—1/2 HP GE BB Nema 440 60 3 3600

75—3 4 HP GE BB Nema 220-440 60 3

COMPENSATORS

50 HP 220 V
50 HP 440 V
100 HP 220 V
100 HP 440 V
125 HP 220 V
150 HP 440 V

We have in stock 10001 Items • Too numerous to list • Controls • MG sets • Slip Ring Motors • Oil Switches, etc. • We can serve you best if we know what your requirements are. We invite your inquiries.

The Above Subject to Prior Sale

WRITE-WIRE-PHONE YOUR INQUIRIES TO

Electric Motor & Machinery Co.

MONROE 1388-1389 P.O. BOX 1273 ROCHESTER 7, N. Y.

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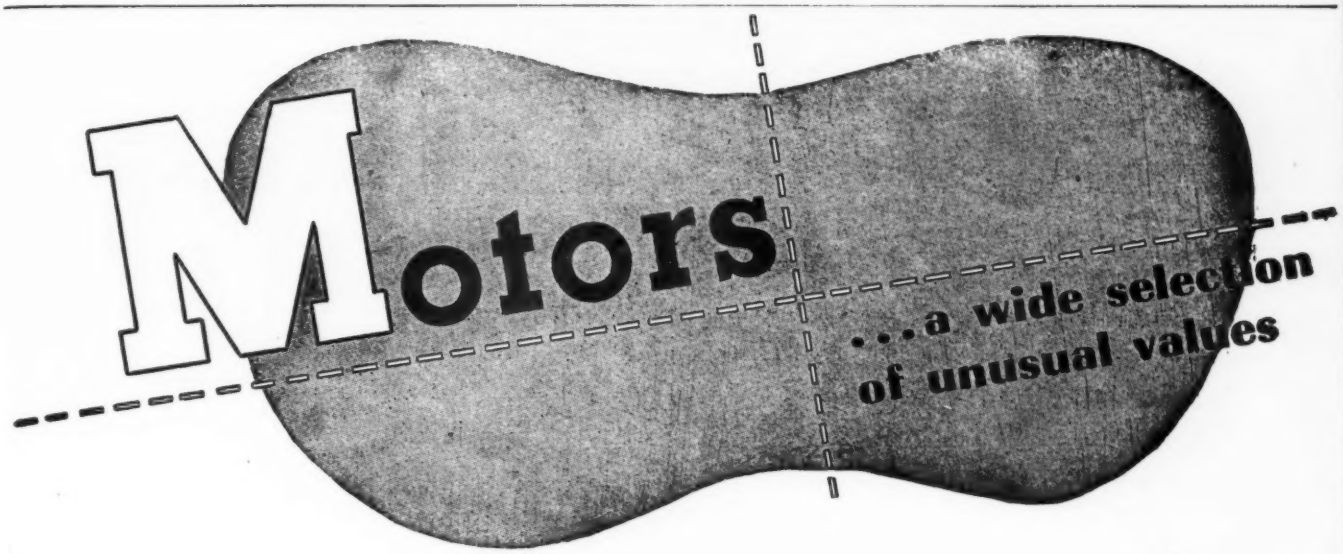


Listed below a few of the motors available in a hurry from Wente

SQUIRREL CAGE

3 Phase, 60 Cycle, 220/440 Volt,

Qu.	HP	Make	Type	Speed
5	200	G.E. 2300v.	FT527	1800
1	150	Al. Ch.		1750
2	125	L. A. 2300v.	Ball Bearing	3600
1	100	R'way 440v.		1200
1	100	West. 2200v.	CCL	1720
1	100	G.E.	I	340
1	100	G.E.	I	290
1	75	Lincoln	IQ	600
1	75	G.E.	KT582	450
6	75	G.E. 440v. new Ball Bearing	K	1800
1	50	G.E.	I	720
2	50	West.	MS 25 cy.	720
1	50	Wag.	BM	495
1	50	Al. Ch.		490
2	50	Al. Ch.		860
1	50	West.	CS	870
1	40	Al. Ch. 2200v.		1160
1	40	Triumph	B12	850
2	35	Al. Ch.	2 ph.	865
2	35	Al. Ch.		865
1	35	Ft. Wayne	2 ph.	900
1	25	G.E.	25 cy.	730
1	30	F.M. 2200v.	HD12B	3600
1	30	Al. Ch.		1200
1	20	Louis A.	KH	1170
1	30	West.	CCL	900
1	30	Wagner	22VBR	860
2	30	Al. Ch.	AN 2 ph.	860
1	30	Century	AS 25 cy.	720
2	30	West. new B.B.	440v.	1750
1	25	R. & M.	K207	1750
1	25	Howell		1200
1	25	Lincoln		900
1	25	G.E.	KT332	900
1	25	Al. Ch.		860
1	25	Rel. (elevator)	T.E.	750
1	25	Al. Ch.		720
1	25	G.E.	M10	720
1	25	West.	CS644C	690
1	25	Al. Ch.		1150
2	25	Al. Ch.		850
1	20	Al. Ch.		1160
1	20	Al. Ch.		860
1	20	Al. Ch.		1700
1	20	Century		1740
1	20	F. M.	KRV	1200
1	20	West.		1200
1	20	Ideal	A	1150
1	20	Cleve.	M-147	900
1	20	Al. Ch.		860
1	20	R. & M.	K-207	900
1	20	West.	CS-644	870
1	20	West.	MS	900
1	20	F. M.	H	870
1	20	West.	CCL	580
1	20	Wagner	CM	445
1	18	West.	MS-4(Elev.)	720
1	15	West.	CCL	1700
1	15	Cr. Wh.	115Q	1720
1	15	Wagner	15TCP-TEFC	1140
2	15	West.	CS-573 25 cy.	725
2	15	West.	MS 25 cy.	725
1	15	West	CS567C 25 cy.	715
1	15	West.	MS 25 cy.	600
1	10	West.	CS 25 cy.	725
1	10	West.	MS 25 cy.	720
2	10	West.	CS473C 25 cy.	615
1	7½	Wagner	MCP-365	1140
1	7½	Lima	RS-405 b.b.	514

SLIP RING

3 Phase, 60 Cycle, & Syn.

Qu.	HP	Make	Type	Speed
1	443	El. Mach.		900 Syn.
1	200	F.M.	BV	600
1	200	Westg. 2200v.		600 Syn.
2	75	F.M. 2200v.	BV-H16B	1800
1	75	G.E.	MT552	865
1	50	Triumph	C12	1150
1	50	Ideal 2200v.	AV	575
1	50	G.E.	IM 25 cy.	700
1	50	Al. Ch.		690
2	40	G.E.	MT336	1200
1	40	Al. Ch.		1160
1	40	W'g 2200v.	CW	870
1	40	Westg.	CW-658-A	870
2	40	Al. Ch.		870
1	40	Westg.	C1753A 25 cy. cr.	730
10	35/15	G.E.	OMT336	1150/550
1	35	Al. Ch.	25 cy.	720
2	35	G.E.	IM	570
1	30	F. M.	AD Alt.	1200
1	20	Imperial	DW-D37	1800 Syn.
1	22	G.E.	ITC5011 (hoist)	680
1	25	Westg.	MW 322A	680
1	25	G.E.	MT342	600
1	25	G.E.	MT356	400
1	20	Triumph	C10	1200
2	15	G.E.	MT302	1200
1	15	G.E.	MT332	720
1	15	Westg.	CS	585
1	15	G.E.	MT556	280
3	10	Westg.	CW464A	1200
1	10	Westg.	HF	1140
1	7½	G.E.	MT182	1750
8	2	G.E.	MT926 slip ring	1800

DC—230 Volt

Qu.	HP	Make	Type	Speed
1	75	Diehl	K11	700
1	100	G.E.	CD123	1200
1	60	Westg. 115v.	SK140L Vert.	1140
1	60	G.E.	EFI	1200
1	40	Rel. 440v.	13LT Vert.	1750
1	40	Rel. 440v.	230T Vert.	1130
1	25	C.W. 440v.	CMC-EH Vert.	1150
2	40	Westg.	SK 123	1150
3	40	G.E.	RC32	1100
8	40	Westg.	SK 140	775
1	35	R. C.	11B	1500
1	35	Al. Ch.		1200
1	35	G.E.	DLC 203	700
1	35	Westg.	SK 163 300/1200 Vert.	
1	30	El. Dy.	15S	625
1	30	Westg.	SK 110L	1150
1	30	Rel. 440v.	131 T Vert.	1150
4	30	Reliance	92 TF	1750
1	27½	G.E.	CVC 116	1750
10	25	Westg.	SK 120	825
3	25	Westg.	SK 103	1150
1	25	Westg.	SK 90	1400
4	25	Westg.	SK 100 L	1150
1	30	G.E.	RC 51B	1150
1	25	Westg.	SK 123 550/1100	
1	25	Al. Ch.	E 120 500/1500	
1	25	J. & L.		625
2	20	Reliance	131T	1000
2	20	Diehl	K914A 500/1500	
1	20	G.E.	RF12 250/1000	
1	20	Lincoln	FKW B.B.	1800
1	20	Westg.	SK70L	1700
6	20	Cr. Wh.	CMC T.E.B.B.	1750
1	20	Cr. Wh.	CMC T.E.B.B.	1150
1	20	Westg.	SK93	1150
14	20	Reliance	92T	1150
1	20	Westg.	SK 120 T.E.	1100
3	20	Westg.	SK 100L	900
1	20	Watson	K	850
3	20	Reliance	131T	850
1	20	G.E.	RC30	750
1	20	Westg.	SK110L-115V	750

DC—230 Volt

Qu.	HP	Make	Type	Speed
4	20	Westg.	SK110L	750
1	20	Cr. Wh.	CW-CMC	600
1	20	Westg.	SK120	500
3	20	Al. Ch.	K	500/1000
1	15	Reliance	46TF	1750
2	15	Westg.	SK63	1750
1	15	Westg	SK113 encl.	1750
1	15	G.E.	RC29A	1700
1	15	Westg	SK93	1150
4	10	Westg.	SK83	1150
4	15	Cr. Wh.	CW-CCM T.E.	1150
1	15	Westg.	SK70L	1250
1	15	G.E.	CD83	1150
1	15	G.E.	RC10	1150
1	15	G.E.	RC29	1150
4	15	Westg.	SK93	850
4	15	Reliance	92TF	850
4	15	R. & M.		1000
1	15	G.E.	CVC-115	925
6	15	Westg.	SK90 Vert.	825
1	15	G.E.	RC20	750
6	15	Westg.	SK110L	675
1	15	Al. Ch.		1075
8	15	Reliance.	131T	550
3	15	Reliance	92T 850/1750	
3	15	Reliance	92T 850/1700	
1	15	Reliance	66T 800/1600	
1	15	Westg.	SK 500/1500	
2	15	Westg.	SK110L 400/1600	
1	15	Triumph	32F 300/600	
1	15	Triumph	225/900	
1	12½	Westg.	SK 750/1500	
7	10	Westg.	SK70	850
2	10	G.E.	RC29	850
2	10	Reliance	66TF	850
20	10	Westg. SK60L-SK60-Reliance 46TF		1150
10	10	Cr. Wh.	CM CHB T.E.B.B.	1750
4	10	Westg.	SK-43	1700
1	10	G.E.	RF11	600/2400
4	10	G.E.	RF10	600/1800
6	10	Westg.	SK80L	500/1500

DC—230 Volt

Qu.	H.P.	Make	Type	R.P.M
23	10	Al. Ch.		500/1000
1	10	G.E.	RF10	400/1200
2	10	Kimble new B.B.	BA324	1750
1	10	Westg.	SK91	250/1000
21	7½	Westg.	SK33	1750
16	7½	Westg.	SK43	1150
20	7½	Westg.	SK60	850
20	5	Westg. & G.E.	K	1750
60	5	Westg. Rel.		1150
50	5	Westg.	SK43	580
75	3½	Westg.	SK33	850
80	3	Westg.	CD925	1725
120	3	Westg.	SK20	1550
60	2	Westg.	SK & CD	1150
50	2	Westg.	SK20	850
40	1½	Westg.	CD	1150
30	1½	Westg.	CD925	550/2200

1—New 40/50 HP Westinghouse, type SK, frame 141, 230 Volt, DC, 300/1200 RPM, ball bearing

6—New General Electric Synchronous Motors Type T.S. 200 H.P. 300 RPM, 2200 volt .8 p.f. Complete with control & separate motor generator exciter set.

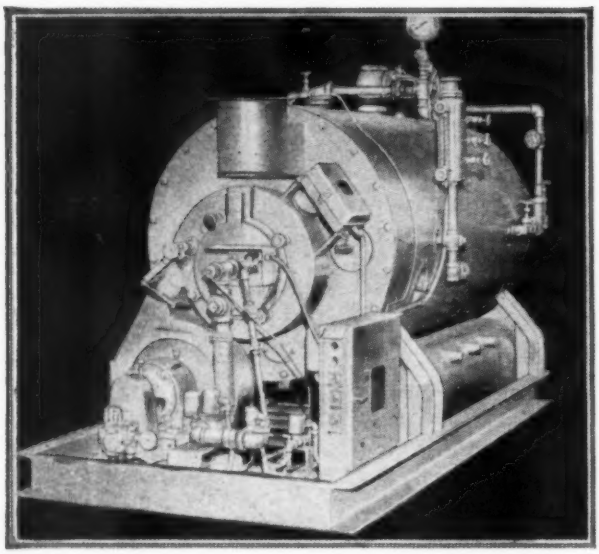
12—1250 K.V.A. 3/60/2300 B. 720 RPM 2 bearing Westinghouse Synchronous Motors or Generators with Direct Connected Exciters. Built 1942. With or Without Hydraulic Couplings

The Wente Electric Co.

Hamilton, Ohio

Rebuilt Motors & Generators

Since 1906



BOILERS

FOR

IMMEDIATE DELIVERY

HERE IS THE

"CREAM OF THE CROP"

IN GOOD USED BOILERS

EXTRA SPECIAL OFFERING!

TWO (2) ALMOST NEW CYCLOTHERM PACKAGE UNITS

Like the above illustration of a Cyclotherm Steam Generator Package Unit, except that the Receiver is a separate unit instead of being built into the unit, as shown. In addition, there is an Instrument Panel to the right of the Smoke Box, which is mounted on the Boiler, containing four (4) Gauges as follows: 1-Oil Suction Pressure, 1-Oil Discharge Pressure, 1-Steam Gauge and 1-Pump Pressure Gauge. The Control Panel on the above lower right is mounted on left side facing the Boiler.

2—90 H.P. (approx.) **Cyclotherm Steam Generator Packing Units** already to operate merely by connecting it up. 125# working pressure. Steam capacity 3000 lbs. per hr. at 150 deg.; Feed Water Temperature 3700 lbs. per hr. at 212 deg. Equal to a 90 H.P. Built in 1942, used only 6-months on Government Boats. **A.S.M.E. and National Board stamped.** Acceptable in any State. Over-all width 60″; length 8′6″; height to Steam Outlet 7′2″. Shipping weight 14,200 lbs. Equipped with Gun-type Oil Burner for #4 Oil; Pump and Receiver Set equipped with 5-H.P., 3/60/220/440 volt Motor. COMPLETELY REBUILT AND RE-WIRED WITH NEW WIRING AND CONTROLS AND ALL INSTRUMENTS HAVE BEEN RECALIBRATED. We have already sold 6 of these Units. The above are ready for quick shipment from New Jersey Shop. Ask for our No. 1002-S.

HERE ARE SEVERAL EXCELLENT WATERTUBE JOBS.

5—250 HP B&W Stirling, 4-Drum, Bent Tube, Water Tube Boilers; 200# WP; complete with Suspension Steel; all Trim; Non-Return Valves; Diamond Soot Blowers; Steam Bend; no Firing Equipment; built 1926; ASME; now under active certificate; located Pennsylvania. Our number 1010-S.

2—600 HP Springfield Sectional Header, Straight Tube, Water Tube Boilers; built 1926; used largely as stand-by in large Municipal New York Plant; 200# WP; 1 Drum 52″ dia. x 14′2″ long; 416-3″x18′ Tubes; Diamond Soot Blowers; Non-Return Valve; extra heavy Bends; Gate Valves; Injectors; Catalog Trimmings; Suspension Steel; Clean-Out & Explosion Doors; Main Steam Header; Feed Water Piping; Steel Catwalks; ASME & Nat'l Board. Now dismantled and stored in New York City, ready for immediate shipment. This is a complete Boiler Plant ready for assembly. 2 VERY EXCELLENT BOILERS. These Boilers are not to be confused with Stirling Bent-Tube type. They are a sectional header Boiler (consisting of 13 header sections per Boiler) sectional headers similar in type and construction with the B&W Sectional header Boilers. They are easy to ship. Our number 1015-S.

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Murray Hill 2-5740-5741 Mu 7-6547

GLOW

SPECIAL—NEW PLASTING GENERATORS

200 Amp., 10 to 15 volt, 1725 RPM, direct current, Master Plating Generators with overhung exciter.

SPECIAL

THREE TRANSFORMERS—333 KVA, 13800 Volts primary, 230/115 volts secondary, single phase, 60 cycle, General Electric, Oil Cooled Transformers.

COPPER OXIDE PLATING RECTIFIERS

500 Amp., 6 volts, Direct Current, for 440 volt, 3 phase, 60 cycle power, General Electric, Model 6RC120F2.

GAS ENGINE—A. C. GENERATOR SETS

7½ KVA, 110 volt, 3 phase, 60 cycle with 4 cylinder Wisconsin Engines, U. S. Army PE99F, complete with switchboard panel.

10 KW, 1800 RPM, 125/250 volt, 1 phase, 60 cycle, A. C. Generator with 4 cylinder gas engine. Complete with switchboard panel.

SIX NEW DIRECT CURRENT MOTORS

25 HP, 1750 RPM, 230 volt, compound wound, Marble-Card motors, Marine type, drip proof.

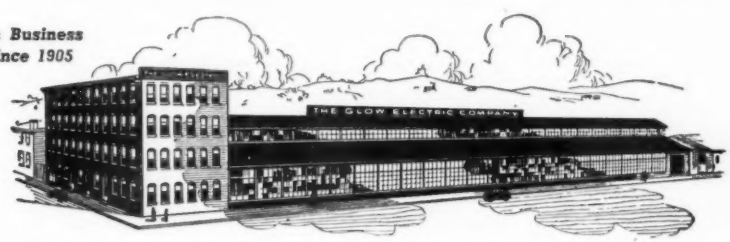
NEW A.C. GENERATORS

5 KVA, 1800 RPM, 120/240 volt, 1 phase, 60 cycle, Master Generators with overhung exciters—generators single bearing for direct connection to driving motor or engine. Complete with switchboard.

SPEED REDUCERS

H.P. Input	Ratio	Input RPM	Manufacturer
1/8	1500 to 1	1800	Winfield H. Smith
1/2	660 to 1	1800	Winfield H. Smith
1	2235 to 1	1800	Winfield H. Smith
1	578 to 1	1800	Foote
3.46	5 to 1	1800	Foote
4	286 to 1	1800	Winfield H. Smith
4.22	6¼ to 1	600	Foote
5	6 to 1	720	D. O. James
5	40 to 1	400	Gears & Forgings
5.72	5 to 1	1750	Foote
7½	8.83 to 1	5000# ft.	King Mach.
7½	54 to 1	1150	Jones
10	15.16 to 1		Patt. Foundry & Mach.
20/50	5 to 1	600/1200	R. D. Nuttall
30	36 to 1	1200	Jones
35/75	10.4 to 1	1170	R. D. Nuttall
	5.3 to 1	1170	
19.5/80.5			
	4⅜ to 1	100/1750	Foote Bros.
100	4¾ to 1	900	Poole Engr.
150	3 to 1	1800	
300	4.04 to 1	3640	Kerr
350	3.6 to 1	885	R. D. Nuttall
375	3.6 to 1	36 00	General Electric

In Business Since 1905



SPECIAL

POWER SAW—Red Star, MULTIPLEX for 20" Saw, Universal head with 5 HP, ball bearing, 230 volt, direct current motor. Complete with table and control.

MILL DRIVE

G. E. Motor Generator Set for Mill Drive complete with driving motor, G. E., type MCF, 500 KW, 550 volt, 900 RPM, D. C. Generator driven by G. E., type ATI, 510 HP, .9 5 P. F., 900 RPM, 2300 volt, 3 ph., 60 cy. synchronous motor with direct connected exciter.

Driving motor, G. E., type MPC, 675 HP, 400 RPM, 550 volt, pedestal bearing, interpole.

WELDER SETS

Amps.	Voltage	Manufacturers	Driven By
75	25	Hobart	3 HP, 220/440 V., 3# ph. 60 cy.
100	25	Lincoln	5 HP, 220 volt, 3 ph. 60 cy.
125	25	Ideal	7½ HP, 220 volt, 3 ph. 60 cy.
150	70	Arc Weld Mach. Co.	No Motor
150	45/35	Wilson Plastic Arc	7½ HP, 230 volt, Direct Current
150	25	Imperial	No Motor
150	6 arc capacity	Arc Weld Mach. Co.	30 HP, 220 volt, 3 ph. 60 cy.
175	55/25	Westinghouse	7½ HP, 220/440 V., 3 ph. 60 cy.
200	60/20	General Electric	1800 RPM—No Motor
200	60	Todd	7½ HP, 220 volt, 3 ph. 60 cy.
200	40	Lincoln	10 HP, 220 volt, 3 ph. 60 cy.
200	25	Lincoln	10 HP, 220 volt, 3 ph. 60 cy.
300	25	Westinghouse	15 HP, 230 volt, Direct Current Motor
300	25	Westinghouse	15 HP, 230 volt, Direct Current Motor
300	40	Wilson, single bearing for direct connection at 1800 RPM	
300	40	Lincoln	20 HP, 440 volt, 3 ph. 60 cy.
300	40	Lincoln, single bearing for direct connection at 1400 RPM	
300	40	Ideal	20 HP, 220 volt 3 ph. 60 cy.
400	20	Wilson	No Motor
500	60	Westinghouse	45 HP, 220 volt, 3 ph. 60 cy.
1000	30	Westinghouse	50 Hp, 220 volt, 3 ph. 60 cy.
1000	60	Westinghouse	92 HP, 220/440 V., 3 ph. 60 cy.
400	40	Lincoln	25 HP, 220 volt, 3 ph. 60 cy.

ELECTRIC CO.

AC & DC MOTORS • GENERATORS • PUMPS
SYNCHRONOUS MOTORS • CONTROL EQUIPMENT
MOTOR GENERATOR SETS • ELECTRIC HOISTS
STEAM ENGINE GEN. SETS • SLIP RING MOTORS

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THE PICK OF POWER EQUIPMENT

TURBINE UNITS—60 Cy.

1—22500 KW General Electric Cond.
1—15300 KVA Westinghouse Cond.
2—1250 KW General Electric Cond.
1— 6250 KVA Allis Chalmers Topping
1— 5000 KVA General Electric Extrac.
1— 3750 KVA Westinghouse Extrac.
1— 3125 KVA Westinghouse Cond.
1— 2500 KVA General Electric Cond.
1— 1875 KVA Westinghouse Con.
1— 1870 KVA Westinghouse Non-C.
1— 1563 KVA Westinghouse Extrac.
2— 1250 KVA General Electric Cond.
1— 375 KVA General Electric Cond.

D. C. TURBO UNITS

1—250 KW Westinghouse, 120/240 V.
1—125 KW General Electric, 125 V.
1— 75 KW General Electric, 125 V.
1— 50 KW Westinghouse, 125 V.

STEAM ENGINE UNITS—60 Cy.

1—800 KW Hamilton Uniflow
1—625 KVA Ames Uniflow
1—500 KVA Chuse Uniflow
2—480 KVA Skinner Uniflow
1—375 KVA Harrisburg Uniflow
1—325 KVA Skinner Uniflow
1—300 KVA Skinner Uniflow
1—150 KVA Ames Uniflow

D. C. STEAM ENGINE UNITS

1—400 KW Ridgway 4-valve 275 V.
1—350 KW Ridgway Uniflow 250 V.
1—300 KW Skinner Uniflow 275 V.
1—250 KW Ames Uniflow 250 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire

SYNCHRONOUS MOTORS

1—300 HP West. 60 cy. 2300 V. 720 RPM (NEW)
1—200 HP Ideal 60 cy. 4000 V. 514 RPM
2—200 HP Burke 60 cy. 2300 V. 600 RPM
1—100 HP G.E. 60 cy. 2300 V. 240 RPM (Super)
1—100 HP G.E. 60 cy. 4000 V. 1800 RPM

DIESEL ENGINE UNITS

2—1600 HP Gen. Motors, 2400 V. 60 Cy. gen.
1— 625 HP Worthington, 240 V. 60 Cy. gen.
1— 440 HP Nordberg, 250 V. gen.
2— 400 HP LeRoi RX1SV (gasoline) eng. only
1— 375 HP McInt. & Sey., 240 V. 60 cy. gen.
1— 300 HP McInt. & Sey., 480 V. 60 cy. gen
2— 250 HP Gen. Motors, 460 V. 60 cy. gen.
1— 150 HP Buckeye 400 RPM engine only
2— 125 HP Winton, 240 V. 80 cy. gen.

WATER TUBE BOILERS

2—1409 HP B.&W. 650-lb., Stokers
1—1373 HP B.&W. 230-lb., Oil Fired
1—1320 HP Springfield 400-lb., Pulverizer
1— 607 HP Wickes 250-lb., Stoker
2—600 HP Springfield 200-lb., Stokers
2— 560 HP Erie City 460-lb.
5—492 HP Heine 180-lb., Stokers
2— 481 HP Springfield 225-lb., Pulverizer
2— 469 HP B.&W. 425-lb., Pulverizer
2— 323 HP Springfield 225-lb., Stokers

TRANSFORMERS—1 Ph. 60 Cy.

4— 6667 KVA G.E. 79660/138,000-34500 V.
3— 2500 KVA Moloney 63/110Y-23/11.5 KV
1— 1500 KVA Pitts. 66000-33000 V. 3 ph.
4— 1500 KVA G.E. 66-13.2/4.6/2.3 KV
3— 750 KVA Pitts. 66000-33000 V.
3— 100 KVA G.E. 66000-6900/11000 V.
1— 7500 KVA G.E. 33000-13800 V. 3 ph.
4— 1500 KVA G.E. 33-13.2/4.6/2.3 KV
2—10000 KVA West. 2640-4580 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
2— 4000 KVA Pitts. 26400-13200 V. 3 ph.
3— 4000 KVA G.E. 27600-13800 V.
2— 1000 KVA G.E. 23000/11500-575 V.
1—10000 KVA West. 13200-4580 V. 3 ph.
1— 5000 KVA West. 13200-480/220 V. 3 ph.
2— 1000 KVA G.E. 11500/23000-575 V.
3— 500 KVA L.M. 7200/12470Y-480 V. 3 ph. New
1— 300 KVA Kuhlman 6900-460 V. 3 ph.
3— 150 KVA G.E. 4150-220 V. 3 ph.
1— 300 KVA West. 450-100 V. (Furnace)
3— 30 KVA West. 440-220/110 V.

INDUCTION MOTORS—60 Cy.

1—1000 HP West. slip ring 2200 V. 360 RPM
1— 700 HP G.E. sq. cage 2200 V. 1800 RPM
1— 500 HP G.E. slip ring 2200 V. 3600 RPM
1— 400 HP G.E. sq. cage 2200 V. 600 RPM
1— 250 HP F.-M. slip ring 220 V. 1800 RPM
2— 120 HP G.E. sq. cage 220 V. 3600 RPM

MOTOR GEN. SETS—60 Cy.

1—1500 KW Allis Chalmers 600 V. DC. 60 Cy.
1—1000 KW General Electric 600 V. DC. 60 Cy.
1— 400 KW Allis Chalmers 275 V. DC. 25 Cy.
2— 300 KW Allis Chalmers 275 V. DC. 25 Cy.
1— 300 KW Westinghouse 250 V. DC. 60 Cy.
1— 250 KW Allis Chalmers 275 V. DC. 25 Cy.
1— 100 KW Westinghouse 125 V. DC. 60 Cy.
1— 50 KW Westinghouse 250 V. DC. 60 Cy.

ROTARIES—60 Cy.

1—2000 KW Allis Chalmers 600 V.
1—2000 KW General Electric 600 V.
2—1750 KW General Electric 250 V.
1—1500 KW Westinghouse 250 V.
1—1000 KW Allis Chalmers 600 V.
1— 750 KVA General Electric 600 V.
1— 500 KW General Electric 250 V.

FREQUENCY CHANGERS

1—2150 KVA G.E. 25/62½ cy. 750 RPM
1—1875 KVA G.E. 25/60 cy. 300 RPM
2—1500 KW West. 25/60 cy. 300 RPM
2—1000 KVA G.E. 25/60 cy. 300 RPM
1—1000 KVA Al. Ch. 25/62½ cy. 375 RPM
1— 938 KVA West. 25/62½ cy. 750 RPM
1— 600 KVA G.E. 60/25 cy. 300 RPM

OIL CIRCUIT BREAKERS

2—	400 A.	37 KV G.E. FHK0136	Outdoor
1—	400 A.	37 KV G.E. FK0136	Outdoor
2—	1000 A.	30 KV Kelman C876	Outdoor
3—	400 A.	25 KV G.E. FK0136	Outdoor
4—	600 A.	15 KV G.E. FHK0139-24BS	Outdoor
1—	600 A.	15 KV G.E. FK037	Pole Type
1—	600 A.	15 KV West. 0-221	Outdoor
2—	400 A.	15 KV G.E. FHK0136	Outdoor

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ELECTRICAL EQUIPMENT—REBUILT and GUARANTEED

MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

SLIP RING MOTORS
3 Phase—60 Cycle

ON.	H.P.	SPEED	MAKE	TYPE
6	52	550	G.E.	IQC-5018*
1	60	1200	G.E.	MT-B-343
1	60	870	G.E.	MTC-5546
1	75	720	G.E.	MT-556
1	75	1750	West.	CI-653C
1	80	575	G.E.	MTC-5562
1	100	1760	Al.-Ch.	ARY-223BS
2	125	430	G.E.	IL-16
1	150	385	G.E.	IM-17
1	150	490	West.	CW-956A
2	200	600	G.E.	IM-17
3 (New)	250**	296	West.	CW-20-53-15
2	300	514	G.E.	IM-17A
1	400	505	West.	CW

*2 phase. **50 cycle.

SQUIRREL CAGE MOTORS
3 Phase—60 Cycle

ON.	H.P.	SPEED	MAKE	TYPE
1	25	1140	West.	CCL
1	30	870	West.	CS-646
2	30	1150	G.E.	KT-326
1	50	900	G.E.	KT-346
1	50	850	West.	CCL
2	50	514	Howell	TEFC
1	75	1750	West.	CS-761#
1	100	495	Al.-Ch.	AN
1	100	580	G.E.	IK-15
2	100	500	West.	CS
1	150	580	West.	CCL
5	150	1800	Howell	K-684
6	200	580	G.E.	KT-566S
1 (New)	200*	2950	West.	CS-8120-TEFC

*50 cycle, 500 volts. #2200 volts.

ADJUSTABLE SPEED D.C. MOTORS

8—40/50 HP, 400/1600 RPM, 230 volt, Cont., Shunt Wound, Reliance and Allis-Chalmers, Ball Bearing, Adjustable Speed D.C. Motors. Complete with Non-reversing Dynamic Braking Controllers.

NEW D.C. MOTORS

25—Allis-Chalmers, 10 HP, 1200 R.P.M., 230 Volt, D.C., EB-83, Dripproof, 40°, B.B.
29—West. 12.5 HP, 600 RPM, 230 volt, DC Marine SK-93, Tot. Encl. B.B., ½ Hr. 55°.

8-VARIABLE VOLTAGE DRIVES

8—40 HP, General Electric Variable Voltage Ward Leonard Drives, each consisting of:
1—40 KW, 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators with exciters.
1—40 HP, 250/1500 RPM, Type CD-1441 DC Motor.
2—Auxiliary, 5 HP, 1750 RPM Type B-284 DC Motors.
1—Enclosed magnetic control providing jog forward, jog reverse, run, fast, slow, and stop. Complete with motor operated field rheostat.

The Above Listings Are Representative of Items Available for Prompt Shipment from Our Cleveland Warehouse. We Also Have a Large Stock of Synchronous Meters, Constant and Adjustable Speed DC Motors, Rotary Converters, Circuit Breakers and Control Equipment.

ELECTRIC GENERATOR & MOTOR CO.

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BOILERS

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All makes & sizes for prompt shipment several attractive assorted sizes.

SPECIAL OFFER
400-HP . . . 175 lbs. Stirling Boilers
3—250 HP Heine Water Tube Type

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Telephone Harrison 0755

TURBO GENERATORS

1—1250 KW General Electric Turbo-Generator, Type ATB, Form HT, 3600 RPM, direct-connected exciter. Wheeler Jet Condenser.
1—2000 KW General Electric Turbo-Generator, 180 lb. pressure, 3600 RPM Generator, Type ATB, 600 Volt AC, 2403 Amp. with Westinghouse-LeBlanc Jet Condenser.
1—1500 KW Westinghouse Turbo Generator with Surface Condenser 4200 sq. ft.

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2—50 KVA 120-208 Volts

1—75 KVA 120-208 Volts

Electric Machinery Generators direct connected to 6 cylinder 900 RPM Waukesha Gas Engines complete with switchboards and necessary cooling equipment. Can be seen in operation.

GAS ENGINE

1—110 HP Bruce McBeth Gas Engine direct connected to 156 KVA 3 Phase 220 Volt Generator with switchboard.

PUMPS

3—8" Rees Roturbo Centrifugal Pumps direct connect to 50 HP 1800 RPM 2300 Volt Motors. Capacity 1200 GPM at 134' head.

Bert Tolbert Machinery Company

505 W Weatherford St Ft Worth, Texas

BOILERS

10 to 1000 H.P.

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Steam, Gas and Electric Power Equipment

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MURRAY HILL 2-5740

DIESELS

New 75 HP CHRYSLER Diesel Power Units, 6 Cyl., Model IND-10, 4 Batteries, Radiator, Fuel Tank, Tool Kit, Silencer.

8—used Hercules Diesel Engines, Model DFXDF, 175 HP, direct coupled to: 85 KW General Electric variable voltage DC Generators.

5—used Buda Diesel Stationary Power Units, 125 HP at 1200 RPM, Model 6 DHG691.

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Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

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1—5 K.W. 110 V. A.C. Gasoline powered.

3—25 K.W. 120/208 V. 3 ph., 4 wire, A.C. gasoline powered. New. Bo't from Army.

1—30 K.W. 127/220 V. 3 ph., 4 wire, A.C. Diesel.

1—60 K.W. 127/220 or 230/400 V. 3 ph., 4 wire, A.C. Diesel.

New and slightly used. Ready to run.

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NO WAITING . . .
IMMEDIATE SHIPMENT

ALL 115 VOLT

Qu.	HP.	Speed	Desc.	Price
20	¼	1800	West.	$28.00
21	¼	1200	West.	34.00
6	⅓	1200	Star BB.	39.00
35	½	1200	West.	48.00
3	1	1800	Sp. proof BB.	109.00
4	1½	1800	G.E. BB.	108.00
28	2	1800	Al. Ch.	121.00
2	3	1800	G.E. BB.	156.00
40	3 KW	2400	G.E. BB. Gen.	278.00
32	5	900	Star D.P. BB.	365.00
61	7½	1400	Star D.P. BB.	367.00

ALL 230 VOLT

Qu.	HP.	Speed	Desc.	Price
10	¼	1800	West.	$29.00
14	¼	1200	West.	35.00
10	½	1800	Comp. round	41.00
15	½	1200	West.	50.00
5	1½	850/1700	D.P. BB.	230.00
7	2	1200	West. T.E.	218.00
3	2	850/1700	Reliance	233.00
30	3	1800	G.E. D.P. BB.	156.00
30	3	1200	Reliance	227.00
28	5	1800	G.E. BB.	248.00
36	7½	1800	T.E. F.C. Rel.	430.00
2	15	1800	G.E.	401.00
3	20	1800	G.E.	464.00
2	25	1800	G.E.	522.00
11	25	900	West. D.P. Int, Duty	838.00

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47 100 KW 1150 3W-125/250 V. Al. Ch. single bearings

America's largest stock of new and guaranteed rebuilt A.C. and D.C. Motors, Generators and Transformers

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CHICAGO'S LARGEST STOCK GUARANTEED EQUIPMENT

D. C. MOTORS

HP	Make	Type	Volts	Speed
430	G.E.	MPC	250	950
300	G.E.	MP	250	425
200	G.E.	RC	230	1150
200	Wtg.	SK	230	1150
195	G.E.	282C	600	641/785
125	Wtg.	SK	230	700/2500
100	W.E.	RC	220	2500
65	Cr. Wh.	CMC	230	600
50C	Cr. Wh.		230	650
40	Al Ch.	Bullock	220	500
40	Roth		230	690
40	W.E.	E60R	220	620
40	Cr. Wh.	CCM	230	575
40	G.E.	LC	250	825/2000
40	W.E.	RC	230	700
35	Cr. Wh.	CM	220	840
30	Nat l.	CS	230	925
30	G.E.	RC	230	1050
30	Cr. Wh.	CMC	230	1800
30	Al. Ch.	Bullock	230	575
30	Cr. Wh.	CCM	220	450
27½	G.E.	CL	220	745
25	G.E.	LC	250	825/2000
25	Wtg.	S-9	220	560/780
25	Chandeyson		230	1000
25	G.E.	DLC	220	500/1000
25	Wtg.	S-7	220	850
25	N.W.	K-15	230	900
25	G.E.	CL	220	725
25	Al. Ch.		220	700
25	Marble Card		220	1800
20	Cr. Wh.	CM	230	775
20	Al. Ch.	E-100	230	1150
20	Al. Ch.		230	650
15	G.E.	CE	220	650/950
15	Wtg.	SK	230	400/1600
15	G.E.	RC	250	500/700
15	G.E.	CE	230	1100
15/7	W.E.	CVC	230	925
15	Cr. Wh.	CM	230	800
15	G.E.	RC	230	1150
15	F.M.	CP	230	1350
15	G.E.	CVC	230	700
15	G.E.	CVC	230	925
14	Sprague	C	230	700/1400
12½	G.E.	C	230	700/1400
12	Wtg.	SK	230	500/1000
10	Wtg.	SK	230	2075
10	Star	SQ	230	600
10	G.E.	CD	230	1150
10	Wtg.	SK	230	850/1700
10	Elec. Dyn.	5S	230	600/1200
10	Holt		220	775
10	G.E.	RC	230	750
10	G.E.	CO	220	700
10	Al. Ch.	E-90	230	850
10	Wtg.	S	220	650
10	W.E.	RC	230	850
10	Wtg.	SK	230	400/1600
10	Wtg.	SK	230	500/1500
7½	Janette	DF	230	1725
7½	G.E.		230	540
7½	G.E.	RC	230	700
7½	Al. Ch.		220	875
7½	N.W.	K-3	220	850
7½	Al. Ch.		220	850
7½	Roth		230	800
7½	Al. Ch.		220	1550
7½	G.E.	CE	230	1525
7½	G.E.	RC	230	1150
7½	Reliance	34T	230	1175
7½	Cr. Wh.	CM	230	1425
7½	G.E.	RC	230	850
7½	G.E.	RC	230	1700
6	W.E.	CVC	220	1725
6	Wtg.	3S	220	975/1200
5	G.E.		230	3500
5	Wtg.	SK	220	1200
5	Wtg.	SK	230	1100
5	G.E.	CD	230	1150
5	Al. Ch.	E-65	230	1750
5	G.E.	RC	230	1700
5	Burke	AM12	220	500/1500
5	Northern	BRG	220	550/850
5	Master		230	1760
5	G.E.	CD	230	1750
5	G.E.	CD	230	450/1800
5	Ideal	D-254	230	1750/2190
5	Roth		230	1000
5	Cr. Wh.	CM	230	960
5	Al. Ch.	E-70	230	1150
5	El. Dyn.	D	230	1130/850
4.5/7.5	El. Dyn.		230	1250/1800
4	G.E.	CQ	230	900
4	Ilg.		220	470
3½	Cr. Wh.	CM	230	690
3½	Wtg.	SA	220	400/1600
3	Star	SF-2	230	3450
3	Peerless		220	1500
3	Ft. Wayne	EF	230	1800
3	G.E.	CD	230	500/2000
3	El. Motor	E-10	230	1800
3	G.E.	BD	230	1750
3	Wtg.	SK	230	1150/1650
3	G.E.	RS6	220	1100
3	G.E.	CQ	230	1100
3	Wtg.	SK	230	1150
3	G.E.	RF	230	500/1500
3	G.E.	CVC	230	1140
3	Cr Wh.	CM	230	1750
3	Elmtr.	E-10	230	1800
3	G.E.	CD	230	1150
3	G.E.	CD	230	1150/1900
3	El. Dyn.		230	975/1300
3	El. Dyn.	fr. 2S	230	840/1120
3	El. Dyn.		230	1800
3	El. Dyn.		230	1750
3	G.E.	CE	230	1100
2.4	Cr. Wh.	SM	230	1335
2.4	Cr. Wh.		230	1245
2.25	Zobell (hoist)	Fr. H-25	220	1100
2.25	Roth	fr. 2S	220	1550/1780
2.2	G.E.	RC	160/230	1000/600
2	W.E.	RC	230	1700
2	Janette	E-10	230	1150
2	Wtg.	S#1	220	1200
2	G.E.	RC	230	1150
2	Roth	fr. 2S	230	1550
2	Cr. Wh.	CL	230	1175
2	M.W.	KIA	230	1150
2	Roth		230	1100
2	Peerless		220	1200
2	G.E.	RC	230	1700
2	Cr. Wh.	CM	230	1625
2	Wtg.	CD	230	1725
2	Cr. Wh.	CCM	230	530
1½	Roth		220	1100
1½	Cr. Wh.	EL	220	830
1½	Cr. Wh.	CCM	230	1300
1½	Star	SF	220/250	1150
1½	Cr. Wh	CCM	230	925
1½	El. Mtr.	E9	230	1200
1½	Cr. Wh.	CCM	230	925/1210
1½	G.E.	CVC	230	1150
1.28/3	El. Dyn.	2S	230	685/912
1.17/2.75	El. Dyn.	2S	230	685/912
1½	Cr. Wh.	SM	230	1320
1	Roth		230	1750
1	G.E.	B-203	230	1730
1	E. Dyn.	D-204	230	1670
1	Wtg.	CD	230	1150
1	Roth vert.		230	1200
1	G.E.	RC	230	1150
1	G.E.		230	1275
1	Janette	E-8	230	1150
1	Elmtr.		230	1800
1	Ilg.		230	1140
1	Cr. Wh.	CM	230	1200
1	Cr. Wh.	CM	230	1075
1	G.E.	CO-1	220	1000
.21/.5	El. Dyn.	D-203	230	1410/1880
1/2	Janette	E-7	230	1150
1/2	Watson	AW-C	220	900
3/4	Master	DM	230	3425
3/4	Peerless		230	1400
5/8	G.E.	RC	230	850
1/2	G.E.	RC	220	600/1200
1/2	Peerless		115	1750
.2/.5	El. Dyn.	fr. 66	220	1500/2000
1/5	Diehl		220	1450
1/8	Emerson	56AA	230	1140
1/8	G.E.	BC	230	3450
1/12	Wtg.	CD	230	2550
60	G.E.	C	115	500/1500
55	G.E.	DLC	115	1000
25	G.E.	RC	115	800
25	G.E.	MCI	125	900
25	Cr. Wh.	CM	115	750
20	Roth		115	1165/685
15	G.E.	RC	115	850
15	G.E.	RC	115	1150
15	G.E.	CQ	115	1000
10	G.E.	CVC	115	700
10	G.E.	RC	110	575/1150
10	N.W.		110	600/1200
5	Wtg.	SK	115	850/1700
5	Sprague	RT	115	1100
5	G.E.	RC	115	1150
5	Sturtevant	D	110	570
4½	Cr. Wh.	CM	115	580/1740
3	G.E.	RC	115	1150
3	G.E.	RC	115	3450
2	G.E.	RC	115	3450
2	G.E.	CVC	115	1100
2	G.E.	RC	115	1150
2	W.E.		110	1400
1½	Diehl	G-305	110	460
1½	Watson	BW	125	550
1	Elmtr.	E	115	2500
1	Janette	E-8	115	1700
1	Janette	E-9	115	900
1	Diehl	L-6	115	475
1/2	Elmtr.	E-7	115	1800
1/2	Janette	DC	115	1725
1/2	W.E.	RC	115	1700
1/2	Sprague	RT	115	500
1/2	Roth		115	350/1400
1/2	Cr. Wh.	CM	115	850

WE ARE ALWAYS IN THE MARKET FOR ALL TYPES OF GOOD MODERN ELECTRIC MOTORS, MOTOR-GENERATOR SETS GENERATORS, TRANSFORMERS, AND OTHER ELECTRICAL EQUIPMENT. SEND US YOUR LISTS FOR BEST CASH OFFERS.

CHICAGO ELECTRIC CO.

1320 W. CERMAK RD.
CANAL 2900

CHICAGO 8, ILL.

MOTORS—M. G. SETS—CONTROL

In Stock—Immediate Shipment—Rebuilt & Guaranteed

230-VDC. CRANE & MILL MOTORS

H P.	Make	Type	R.P.M.
(1) 2½	G.E.	C.O.-1803 (C.P.)	650
(1) 3	G.E.	C.O.-1803	700
(1) 5	G.E.	MD-101	800
(1) 6	G.E.	C.O.-1805	1150
(1) 7½	G.E.	C.O.-1804	725
(1) 7½	Westghse	X-4	750
(1) 9	G.E.	MD-102 (back axle)	(C.P.)975
(1) 10	G.E.	C.O.-1805	925
(1) 10	G.E.	C.O.-2504	700
(1) 10	G.E.	C.O.-1805	925
(5) 14/19	C.W.	B.W. (back axle)	675/560
(4) 14/19	C W.	B.W.	675/560
(1) 15	G.E.	C.O.-1806	875
(1) 17	G.E.	MD-103	700
(1) 21	G.E.	Type-52	345
(1) 20	Westghse	HX-6	650
(1) 25	G.E.	C.O.M.-1828 (C.P.)	850
(2) 35	G.E.	C.O.-2506	650
(1) 30/45	C.W.	Size DW	620/520
(1) 30/45	G.E.	MD-104½ (C.P.)	625/500
(1) 52	Westghse	X-10	740
(1) 54/80	C W.	FW	575/480
(2) 50	G.E.	MD-105 (C.P.)	475
(1) 65	G.E.	C.O.-1811 (C.P.)	800
(1) 65	G.E.	C.O.-1811	800
(1) 60	Westghse	MTA-NO-2 (back axle)	

(All Above Series Wound Except Where C.P. Compound Wound)

230-VDC. (VARIABLE SPEED)

H.P.	Make	Type	R.P.M.
(1) 3/4	G.E.	B.D.-225 (SH)	600/1800
(1) 2	G.E.	RLC-111 (SH)	500/1500
(1) 3	G.E.	CR-3	500/1500
(1) 3 (D.P.B.B.)	Reliance	14-T (SH)	1200/3600
(1) 5	G.E.	RLC-115 (SH)	250/1000
(1) 5	G.E.	RF-9 (SH)	450/1350
(1) 5	Westghse	SK-35 (SH)	1150/1650
(1) 6	G.E.	RF-9 (SH)	450/1350
(1) 7½	G.E.	RF-10A (SH)	450/1350
(1) 7½	Westghse	SK-70 (C.P.)	450/1800
(1) 7½	Westghse	SK-70	600/1000
(1) 7½	Westghse	SK-60-L (C.P.)	650/1300
(1) 8	Westghse	SK-100-L (SH)	300/1200
(1) 8½	G.E.	RF-9 (SH)	600/1800
(1) 10 (115-v)	Elec. Dy.	7-S	250/1000
(1) 10	Westghse	SK-80-L	800/1500
(1) 10 (D.P.B.B.)	G.E.	CD	850 1250
(1) 10/15	Al. Ch.	EB-100 (SH)	575/1725
(1) 15	G.E.	RF-11 (SH)	400/1600
(1) 15	Reliance	131-T (SH)	500/1500
(1) 19	Westghse	SK-100-L (C.P.)	600/1200
(1) 20	Triumph	Comp.	250/1000
(1) 20	G.E.	RLC-702 (SH)	250/1000
(1) 25 (D.P.B.B.)	Westghse	SK-143(SH)	400/1600
(1) 25	G E.	CD-1258-Y (SH)	200/800
(1) 25	G.E.	RF-13 (SH)	400 1200
(1) 25	Reliance	262-T (C.P.)	500/1500
(1) 30	Westghse	SK-163 (SH)	400/1200
(1) 35	Westghse	SK-160 (C.P.)	500/750
(1) 40	G.E.	CD-1238 (SH)	400/1200
(4) 100	Reliance	1050-T (SH)	400/1200

SLIP RING (CONSTANT DUTY) 220/440-V., 3-PH., 60-CY.

H.P.	Make	Type	R.P.M.
(1) 3	G.E.	M.Q.-1801 (2-PH)	1080
(2) 7½	G.E.	M.T.-201 (550-V)	1200
(1) 10	G.E.	I.Q.- (2-PH)	1120
(1) 38	G.E.	I-M	1200
(1) 200	C.W.	(2200-V)	590
(1) 250	Westghse	C.W.	435
(1) 400	G.E.	M.T.-412	600
(1) 500	Al. Ch.	A.N.	585
(1) 500	Westghse	C.W. (2200-V)	360

CONSTANT SPEED 230-VDC MOTORS

H.P.	Make	Type	R.P.M.
(2) 2	Al.-Ch.	E-50	1750 SH.
(1) 3	Reliance	T-224	3500 SH.
(1) 3	G.E.	CD-55	1150 SH.
(1) 5	Westghse	SK-35	1150 SH.
(2) 5	Westghse	SK-40	850 SH.
(1) 5	G.E.	RC-27A	1150 SH.
(1) 5 (new)	Al.-Ch.	EB-65	1750 SH.
(2) 7½	Westghse	SK-60	850 C.P.
(5) 7½	Westghse	SK-43	1150 SH.
(1) 7½	Westghse	SK-5L	550 C.P.
(1) 7½	Westghse	SK-40 (115-V.)	1150 SH.
(1) 10 (new)	Al.-Ch.	EB-80	1150 SH.
(1) 10	Westghse	SK-50L	1300 SH.
(1) 15	Al.-Ch.	Shunt	800
(1) 15	Westghse	SK-100L	850 SH.
(1) 15	C.W.	CCM	800 C.P.
(2) 20 (new)	Elec. Dy.	182N (Enc.) (B.B.)	1500 C.P.
(1) 25	Westghse	SK-100L	1100 SH.
(1) 30	G.E.	DCL-201	1100 SH.
(1) 35	Westghse	SK-130	850 SH.
(1) 50	Westghse	SK	1700 SH.
(1) 75	Reliance	T	875/1200 C.P.

SLIP RING MOTORS (CRANE TYPE) 220/440-V., 3-PH., 60-CY.

H.P.	Make	Type	R.P.M.
(2) 2	G.E.	MTC-5140	1200
(1) 2	G.E.	MTC-5932	1130
(1) 3	G.E.	MTC-5180	900
(1) 5	G.E.	MTC-5180	1200
(4) 10	G.E.	MTC-5952	1165
(1) 11	L. Allis	S.H.	1200
(1) 15	G.E.	ITC-5008	1125
(1) 22	G.E.	ITC-5011	
(2) 35	G.E.	MTC-5336-Y (Encls)	550
(1) 35	Westghse	C.I.	720
(1) 37	G.E.	ITC-5011	1200
(1) 40	Westghse	C.I.-746-A	575
(1) 50	Westghse	C.I.-6440	870
(1) 52	G.E.	ITC-5013	600
(1) 52	G.E.	ITC-5012	900
(1) 200	Westghse	M.W.	580

MOTOR GENERATOR SETS
1—200 K.W., 250-275 V. DC. Allis Chalmers, factory built set with 288 HP. Syn. motor, 80% P.F., 440/3/60 cy. A.C. & D. C. panel, O.C.B. & starting equipment.

1—150 HP., Electro Dynamic Variable Speed, 3-bearing, Frame 75-S, Comp. Interpole, 250/500 RPM., 2 hrs. 185 HP., with Monitor Control Panels, built in Resistance, Auto 4-step acceleration, non-reversing, P.B. control.

T. B. MAC CABE COMPANY.

4312 CLARISSA STREET — PHILADELPHIA, PENNA.

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us if you don't see the item you need. This listing is only a part of our large stock.

M-G SETS

300 KW. Gen. Elec. type MPC gen. DC 170 volts 1760 amp. coupled to 450 HP G.E. motor DC 250 V. 1150 RPM (can furnish A.C. drive).

225 KW G.E. MPC gen. DC 125 V. coupled to 350 HP Whse. synch motor 3/60/440 V. 900 RPM.

150 KW Gen. Elec. type MPC gen. DC 125 V. coupled to 225 HP sq. cage motor 3/60/2200 V. 1200 RPM, 2 brg.

50 KW Cr. Wheeler type CC generator DC 125 V. coupled to 80 HP C-W motor sq. cage 3-60-220/440.

40 KW Martin rotary converter, input 3/60/220 v., output DC 230 v., with panel.

37½ KVA Whse. AC gen. 3/60/240 V. coupled to 50 HP Whse. SK motor DC 230 V. 1150 RPM, 3 brg.

Others available—special units built to order.

SPECIAL — 8 — 400 amp. Hobart Arc Welders, 220/440 V. AC Drive.

SQUIRREL CAGE MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1	250	Gen. Elec.	I-K	600
3	165	Gen. Elec.	I-K	1800
1	150	G.E. 2200 V.	I-K	1200
1	60	Gen. Elec.	I-K	3600
2	50	Whse. 2200 V.	CS	900
1	40	Gen. Elec.	I-K	900
1	30	Gen. Elec.	I-K	720
1	25	Gen. Elec.	I-K	600

D. C. MOTORS

H.P.	Mfg.	Type	Volts	Speed
450	Gen. Elec.	MPC	230	1150
125	Cr. Wheeler	125H	230	500
100	Cr. Wheeler	101H	230	550
100	Gen. Elec.	BRC	115	1150
75	Cr. Wheeler	125H	230	350/750
75	Whse.	S136	125	475
75	Gen. Elec.	DLC	230	400
65	G.E. Northern	C	230	375/750
60	Diehl dynamom.	R10	250	500/2000
50	Whse.	SK	230	1150
50	G.E. Sprague	LC	250	700
50	Whse.	SA	230	450/1350
50	Cr. Wheeler (5)	50H	230	700
50	Whse.	SK	230	500/1500
50	Gen. Elec.	RC33	230	1100
40	Gen. Elec.	LC	230	500/1200
40	Whse.	SK153	230	575/1150
40	Roth	S	115	850
30	Gen. Elec.	LC	230	650/1300
30	Sprague	dynamom.	250	800/2000
25	Gen. Elec.	DLC	115	750
25	Roth	elevator	230	725
25	Whse. enclosed	SK	230	600
25	Whse.	SK	230	950
25	Sprague dyna.	IC	115	700/1500
25	Gen. Elec.	FFC32	230	800
25	Star b.b.	SB15	230	1750
20	Imperial int. dty.	D37	230	1200
20	Gen. Elec.	LC	230	575
20	Gen. Elec.	DLC	230	500/1500

25 CYCLE MOTORS

H.P.	Mfg.	Type	Speed
450	Whse. 2200 v.	CW sl. rg.	750
150	Whse.	HD sl. rg.	500
100	Whse.	CCL sq. cg.	500
75	Gen. Elec.	I sq. cg.	750
50	Allis Ch.	ANY sl. rg.	1500

SYNCHRONOUS MOTORS

H.P.	Mfg.	Type	Volts	Speed
750	Allis Ch.		220/400	1200
300	Whse.	ped.	220/440	900
200	Elec. Machy.		220/440	600
150	Elec. Machy. New	SPF	220/440	360
100	Gen. Elec.	ATI	220/440	1200
50	Gen. Elec.	TS	220/440	900

AIR COMPRESSOR — 14x12 Ing. Rand 500 CFM, 100#, with Tank—BARGAIN

CENTRIFUGAL PUMPS
8" Alberger, 2000 gpm @ 80 ft.
6" Platt, 1000 gpm @ 230 ft.
8" Worthington, 2000 gpm @ 200 ft.

SLIP RING MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qu.	H.P.	Mfg.	Type	Speed
1	400	Gen. Elec. 3 brg.	I-P	450
1	300	Burke	EMV	225
1	250	Cr. Wheeler	SR	600
1	200	G.E. 2200 v.	I-M	360
1	150	G.E. 2200 v. vert.	I-M	1200
1	75	Allis Ch. 2200 v.	ANY	720
1	60	Whse. 2200 v.	CW657	1800
1	60	Gen. Elec.	I-M	720
1	50	Whse.	MW332	900
1	50	Gen. Elec.	I-M	600
1	50	G.E. 2 phase	I-M	900
1	40	Gen. Elec.	MT582	1200
2	40	Gen. Elec.	M546	514
2	40	Allis Ch.	ANY	450
1	40	G.E. 550 v.	MT536	900
1	37	G.E. int. duty	ITC	600
3	35	Lancashire b.b.	late	1800
1	35	Whse. int. duty	CW	900
2	30	Allis Ch.	ANY	900
1	25	Wagner	19TBR	1200
1	25	Gen. Elec.	I-M	600
1	20	Burke	EMV	1200
1	20	Wagner	19TR8	900

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Gen. Elec. 1 brg.	MPC	125/170	1150
100	Fair Morse	TR	250	800
75	Whse.	S	125	600
60	Gen. Elec.	DLC	250	450
50	Cr. Wheeler	CC	125	1800
50	Cr. Wheeler	CCD	250	850
35	Gen. Elec.	DLC	250	900
30	Lincoln b.b. 600 amp.		50	1200
25	Whse.	S	125	1200
25	Gen. Elec.	DLC	125	900
25	Gen. Elec.	RC	250	900
20	Allis Ch. (2)		125	475

SPECIAL — 3 — Oil Gear Co. Pumps, 1100 lbs. 104 gpm., on steel base — BARGAIN.

60 CYCLE A.C. GENERATORS

KVA	Mfr.	Type	Volts	Speed
300	Whse.	ped.	240/480	900
300	Elec. Machy. 3 brg.		240/480	720
200	Gen. Elec.	ATB	2300	600
165	Elec. Machy.	BRKT	240/480	900
150	Allis Ch. 25 cycle		240/480	500
100	Cr. Wheeler		240/480	600
75	Gen. Elec.	ATB	240/480	1200
31	Whse. (4)	b.b.	120/208	1200
10	Whse. (5) NEW	b.b.	240	1200

ARTHUR WAGNER COMPANY

1436-38 W. RANDOLPH STREET — CHICAGO 7, ILL. — MONroe 7409

TURBO GENERATORS

750 KW., 3 ph., 60 cy., 480V. 3600 Allis Chalmers to a Moore extraction type Turbine with board.

500 KW., 3 ph., 60 cy., 480V. Westgh. non cond. Turbo Generator with board.

937 KVA., 3 ph., 60 cy., 2300V. Gen. Elec. cond. Turbo Generator.

ROTARY CONVERTER

1—1500 KW., 250 V. Westgh. complete.

1—156 KVA., 3 ph., 60 cy., 240 volt Gen. Elec. to an 8 cylinder Buffalo engine only 5 years old, little used.

The above are just a few of the thousands of items we have in Motors, Generators, Turbo Generators, Engine Generators, Motor Generators, Transformers, Circuit Breakers, etc. Please send us your inquiries.

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Power Plant Equipment Company

8493 Hegermen St., Phila. 36, Penna.

POWER PLANT EQUIPMENT

Special Offerings

TURBO-GENERATORS

1—3000 KW. 2300 V. Cond.
1—2500 KW. 2300 V. Cond.
1—1250 KW. 2300 V. Cond.
1— 250 KW. 240 V. N. C.
1—2000 KW. 600 V. Cond.
2—1000 KW. 2300 V. Cond.
1— 750 KW. 480 V. N. C.
1— 500 KW. 440 V. N. C.
1— 500 KW. 550 V. N. C.
1— 375 KW. 440 V. Cond.
1— 120 KW. 440 V. N. C.

ENGINE GENERATORS

1—540 KW. Uniflow 480 V.
1—150 KW. 480 V.
1—600 H.P. Uniflow Eng.
1—163 KW. 550 V.
2—600 KW. 2300 V.

TURBINES ONLY

1—375 H.P. with gears
1—210 H.P. Terry 250#
1—100 H.P. G.E. with gears

BOILERS

1—1390 H.P. 400# Coal
1— 990 H.P. 200# Coal
1— 620 H.P. 200# Coal
3— 500 H.P. 160# Coal
1— 360 H.P. 190# Coal
2— 310 H.P. 250# Coal
2— 100 H.P. 100# Oil
2— 175 H.P. 200# Oil
1— 200 H.P. HRT 160#

AIR COMPRESSORS

2—3400 CFM 100# Motor
1—3000 CFM 100# Motor
1—1972 CFM 100# Motor
1—1573 CFM 100# Motor
2—1228 CFM 100# Motor
1—1330 CFM 50# Steam
1—1700 CFM 100# Steam
1— 600 CFM 350# Steam
1—5000 CFH 600# Belted
1—1000 CFH 3000# Beted

PUMPS

1—Vacuum, Size 14"x22"x24" Steam Driven
1—3000 GPM 65' Head, Motor Driven
1— 600 GPM, 162' Head Motor Driven

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Mchy. Bldg., Boston, Mass.

The buyer Must Be Satisfied—Always

SLIP RING MOTORS
3-PH., 60 Cy.

HP	Volts	Make	Speed
900	2300	G.E	900
600	2200	G.E	720
500	2300	G.E.	900
300	440	Al. Chal.	900
250	2300	G.E.	600
250	440/550	G.E.	600
200	2200/440	G.E.	600
150	2200	G.E.	450
150	2200/440	G.E.	600
150	440/220	G.E.	1200
125	440/220	Whse.	1200
125	440/220	G.E.	1200
125	440/220	G.E. (Hoist)	900
100	440/220	G.E. MTC	900
100	440/220	Whse.	1200
100	440/220	G.E.	1200
80	440/220	G.E. (MTC)	900
75	2200	Al. Chal. (new)	900
75	440/220	G.E. (MTC)	600
75	2200/440	G.E.	1200
50	2200/440	G.E.	600
75	550	G.E.	900
40	2200	Whse.	900

OUTDOOR OIL CIRCUIT BREAKERS

1—New 400 Amp. Type FK, 136-1328A. General Electric, 3PST, 25,000 Volt Oil Switch, Interrupting Capacity 125,000 KVA, complete CT's PT's, etc.

1—3000 ampere, type FK 25, General Electric, 3 pst, 600 volt.

SYNCHRONOUS MOTORS
3-PH., 60 Cy.

500	2200	Al. Ch.		450
300	440/220	G.E.	ATI	600
300	4150/2300	Cr. Wh.	SYN	900
300	2200	Whse.	G	720
300	440/220	Al. Ch.		600
250	4000/2300	G.E.	TS	1200
240	2200	G.E.	ATI	600
200	4150/2300	Whse.	G	1800
200	2200	G.E.	ATI	514
150	4150/2300	Whse.	G	1800
110	440/220	G.E.	TS	1800
100	440/220 25 cy.	G.E.	TS	375

TRANSFORMERS
60 Cycle

8— 833 kva Whse., 11000-2300 V.
1— 500 kva., Whse., 3 Ph., 13800-230 V
3— 250 kva., Whse., 13,800-460.
3— 100 kva., G.E., type H 2400-240-480.
8— 100 kva., G.E., type H-KDD, 6900/11950Y-230/

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G	IK	1200
500	440/220	G.E.	IK	900
400	2200/440	Whse.	CS	720
400	2200/440	G.E.		600
400	550	G.E.	IK	720
350	440	G.E.	IK	900
200	440/220	Whse.		1200
200	2200	G.E.		1800
200	440/220	Wagner	RP	1800
200	2200 550	Al. Ch.	AR	900
150	2200/550	Al. Ch.	AR	1800
150(3)	440 220	G.E.	KT	1200
125	2200	G.E.	KT	600
100	440	G.E.	IK	450
100	2200	G.E.	KT	1800
100	440	Whse.	CS	1200
74	2200	G.E.	KT	900
50	2200	Al. Ch.		720

MOTOR GENERATOR SETS

1—100 kw, 250 v., 900 rpm, Whse., conn. to 150 hp. 2300 v., 60 cy., sq. cage motor
1—60 kw, 250 v., 1200 rpm, G. E., conn. to 90 hp. 440/200 v., 60 cy., syn. motor
1—60 kw, 125 v., 1200 rpm, Whse., conn. to 75 hp. 440/220 v., 60 cy., syn. motor.
1—35 kW, 125 V., 1800 RPM, G.E. conn to 50 HP., 440/220 V., 60 cy., squirrel cage

A.C. GENERATORS

1—300 kva, 600 rpm, 440/220 v., G. E.
1—225 kva, 600 rpm, 440/220 v., G. E.
1—190 kva, 514 rpm, 2200/440 v., G. E.
1—150 kva, 900 rpm, 440/220 v., G. E.
1— 98 kva, 1200 rpm, 440/220 v., G. E.
1— 86 kva, 360 rpm. 480/240 V. G.E.

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

POWER PLANT SPECIALISTS

SPECIAL OFFERING

1—Locomotive Type Boiler 150 H. P. 120 Lb. P. S. I. built 1928 complete with oil burners and all trim.

1—200 H. P. Locomotive type boiler —150 Lb. P. S. I. Built in 1926— complete with oil burners and all trim.

Both above boilers re-conditioned 1941 used 3 years thereafter.

Also Boilers 150-1500 H.P. and upward (at various pressures).

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State your needs—We will post you promptly.

Our present stock consists of over 5000 items, in our warehouse consisting of all types of TURBO GENERATORS, SWITCHGEAR, AIR and OIL CIRCUIT BREAKERS, RELAYS of all types, TRANSFORMERS, PUMPS, 800 VALVES—NEW and USED, up to 1500# pressure, and other items used in Industrial and Power Plant Construction.

HOWE BROTHERS

324-328 PEARL ST., NEW YORK 7, N. Y.

***Phone*—Worth 2-2708—2709—2710**

TURBINE UNIT

1—2500 KVA, Westinghouse, 3 ph., 60 cy. 460 V. 3600 RPM turbo unit, with direct connected exciter, surface condenser and auxiliaries.

Priced Attractively for Quick Sale

BREW, WOLTMAN & CO., INC.

50 Church St., New York 7, N. Y.

1800' Air Compressors

2—Sullivan type WN-31 air compressors, angle compound, 2 stage, direct connected to General Electric 300 H.P. synchronous motors, exciters, control panels, after-coolers, air receivers, etc.

New 1943 **Immediate Delivery**

Other sizes of late type machines available

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910 N. Marshfield Ave. Chicago, 22, Ill.

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt Street
New York, N. Y.

A.C. TURBINE UNITS

6250 KVA GE 2300 v., cond.
3125 KVA GE 2300 v., 300#, cond.
1560 KVA Wghse. 480 v., (bleeder)
1250 KVA GE 2300 v., cond.
1250 KVA Al. Chal. 480 v., non-cond.
750 KVA GE 2300 v., 250#
625 KVA Wghse. 480 v., (bleeder)
625 KVA Al. Chal. 2300 v., 85# B.P.
625 KVA Elliott 480 v., non-cond.
312 KVA GE-Moore, 450#
250 KVA GE, non-cond.
187 KVA GE, non-cond.
125 KVA CW-Moore, non-cond.
110 KVA Al. Chal.-Elliott, non-cond.
50 KVA GE-Terry, non-cond.

ENGINE UNITS (UNIFLOW)

750 KVA GE-Chuse, AC
625 KVA GE-Skinner, AC
350 KVA GE-Ames, AC
200 KW (2) GE-Ames Ver. 250 v., 3W, DC

DIESEL UNITS

700 KVA Fairbanks Morse
600 KVA (2) Fairbanks Morse
250 KVA Fairbanks Morse
225 KVA Wghse.-Werthington
150 KVA FM-FM
125KVA GE-Worthington
118 KVA (2) GE-Winton
90 KVA Ideal-Worthington
65 KVA FM-FM

ROTARIES, & M. G. SETS

2600 KW (2) GE, 250 v. Rotaries
150 KW GE 250 v.-440 v. Syn. Motor

SYN. CONDENSER

3000 KVA Al. Chal. 3-60-2300 v.

MOTORS

2100 KKVA (2) GE 4600 Syn., 514 RPM
600 HP Al. Chal., slip ring, 2200 v., 585 RPM
400 HP Wghse., slip ring, 2300 v., 435 RPM
200 HP FM syn., 2300 v., 600 RPM

SURFACE CONDENSER

2100 sq. ft. Wheeler
1450 sq. ft. After-cooler

REBUILT POWER EQUIPMENT

READY TO SHIP!

SLIPRING MOTORS—3 PH., 60 Cy.

H.P.	Make	Volts	R.P.M.	Type
400	Westg.	2200	435	CW
200	G.E.	220/4440	1200	M-1
15	Triumph	220	1150	
2.25	Northwestern	440	1080	HEW1½
¼	Howell	220	1800	

ALTERNATING CURRENT MOTORS
3 ph., 60 cy.

H.P.	Make	Volts	R.P.M.	Type
100	G.E.	220	1745	I
1/20	Westg.	220/440	1750	CS drip proof
15	G.E.	220	900	ITC
15	Triumph	220	1150	

COMPRESSORS

2—315 cu. ft. 100# pres. Ingersoll-Rand Models 315 and 315A Portable Air Compressors with 105 HP. Waukesha Oil Engines complete with accessories.

1—610 cu. ft. 100# pressure Burry Horiz. Compressor.

VARIABLE SPEED MOTORS
230 VOLT D. C.

H.P.	Make	R.P.M.	Type
20	Westg.	500/1500	SK
15	Reliance	500/1800	
15	Westg.	875/1600	SA
10/15	Electro Dy.	600/1200	
10	Westg.	800/1600	SA
10	Cr. Wh.	690/895	CMC
10	Reliance	850/1700	
10	J.C. Curran	950/1230	
10	G.E.	625/1250	LC
10	Westg.	565/1130	S-6
10	Westg.	400/1600	SA
7½	Westg.	650/1300	
7½	Westg.	425/850	SK
7	Westg.	660/1050	S
4	G.E.	850/1700	LC-8
3	G.E.	400/1200	RLC-114
3	Roth	500/1000	RS

SERIES WOUND MOTORS

H.P.	Make	Volts	R.P.M.	Type
175	G.E.	230	475	MD
35	Westg.	230	550	49D
32	G.E.	230	450	801
32	Shaw	230	485	5L2E
28	Westg.	220	385	904
25	Westg.	230	600	MT
15	Westg.	220	650	
15	Cr. Wh.	220	270	SM
10	Westg.	230	750	MT-00
7½	Westg.	230	725	L
7½	Westg.	230	975	S
3½	Westg.	230	1200	L

230 VOLT DC MOTORS

H.P.	Make	R.P.M.	Type
80	Westg.	490	76-A
25	G.E.	650	MD
25	Westg.	825	SK113
20	Westg.	600	M
20	Westg.	750	SK
20	Westg.	975	S-6
20	Western Elec.	1150	E-40-M

D. C. CLARK CONTROLLER

1—250 HP Clark Vari Time magneto controller 230 v. DC reversing, used for plugging service. Can also be used for non-reversing.

MOTOR GENERATOR SETS—
250 & 500 V. D. C.

2—150 KW. 250/275 v. DC 900 rpm. 546 amps. compound wound Ridgeway Generators, direct connected to 1—225 HP. 2200 v. 900 rpm. 3 ph. 60 cy. Ridgeway Synchronous Motors.

1—75 KW. 250 v. DC Westg. type SK Generator direct connected to 220 or 440 v. 3 ph. 60 cy. Induction Motor.

1—30 KW 250 v. DC generator direct driven by 46.5 HP 1750 rpm. 220/440 v. 3/60 Westg. Motor.

1—30 KW 250 DC 1150 rpm. Reliance Generator dir. driven by 50 HP 220 or 440 v. 3/60 motor.

2—20 KW 1700 rpm. 250 v. Westg. SK gens. dir. driven by 30 HP 220 or 440 v. 3/60 cy. motors.

1—3 KW 1350 rpm. 250 v. type S Westg. Gen. dir. conn. by coupling to 5 HP 1350 rpm. 110 v. Westg. Mtr.

1—10 KW. 250 v. DC Generator direct driven by 220 or 440 v. 3 ph. 60 cy. motor.

INDUSTRIAL TRUCKS

6 Automatic type LO-5 Low Lift Trucks capacity 5 ton, platform type. Equipped with towing coupler and bumper for pushing cars.

7—New 4 ton Yale & Towne model Y8W Multi-Stroke Hand Lift Platform Trucks.

WRITE, WIRE OR PHONE YOUR ELECTRICAL NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 phase 25 cycle, 220/440 Volts

H.P.	Make	Type	Frame	RPM
5	West.	CS		750
5	West.	CS		750
5	West.	CS		750
5	West.	CS	453	750
5	West.	CS	453	750
5	G.E.	KT	948	1430
5	G.E.	KT	948	1430
5	G.E.	KT	948	1430
10	G.E.	KT	312	750
10	Wagner	19TBM		750
10	Wagner	19TBM		750
10	Wagner	19TBM		750
15	G.E.	I Form K		750
15	West.	CS	4052	750
15	West.	CS	573	750
15	West.	CS	573	750
15	West.	CS	573	750
15	G.E.	KT	303	1500
20	West.	CS		730
20	West.	CS	645	715
20	West.	CS	645	715
20	West.	CS	405	675
20	West.	CS	405	675
25	West.	CS		730
25	West.	CS		715
40	G.E.	I Form K		750
40	G.E. (S. R.)	MT	347	750
40	G.E. (S. R.)	MT	347	750
50	G.E. (S. R.)	MTC	5537	750
75	G.E. (b.b.)	KT	557	750
75	G.E.	KT	559	500
75	G.E.	I Form K		500
75	G.E.	I Form K		500
75	G.E.	I Form K		500
75	G.E. (2200 v.)	I Form K		750
100	G.E.	I Form K		750
100	West.	CS		750
100	West. (2200 v.)	CS	871C	730
100	West. (2200 v.)	CS	871.52C	1460
100	West. (2200 v.)	CS	871.52C	1460
125	West. (S. R.)	CW		480
150	G.E.	I Form K		365
150	Crocker Wh.	75R		725
150	G.E. (2200 v.)	I Form K		750
150	G.E. (2200 v.)	I Form K		750
150	Allis Ch.	Slip Ring		720
150	G.E. (2200 v.)	KT b.b.	557Y	1470
200	West. (2200 v.)	CS	1013	480
200	G.E. (2200 v.)	I Form K		485
200	G.E. (S. R.)	I Form M		480
200	G.E. (S. R.)	I Form M		480
200	West. (S. R.)	CW	1011	480
200/400	G.E. 2 Sp.	K	569BS	740/1485
225	Elec. Mach. (2200 v.)	Synchronous		500
300	West. (S. R.)	CW		500
500	G.E. (2200 v.)	KT		487
500	G.E. (550 v.)	I Form K		500

MOTORS
25 Cycle—3 Phase—550 Volt

				RPM
7—	25 HP	West.	Type CS	3/25/550/750
1—	30 HP	West.	Type CS	3/25/550/750
1—	60 HP	West.	Type CS	3/25/550/750
1—	65 HP	West.	Type CS	3/25/550/500
1—100 HP		West.	Type CS	3/25/550/750

TRANSFORMERS

3—150 KVA West., OISC—25/1/2300/460.
3—200 KVA West., OISC—25/1/2300/460
3—500 KVA Pitts., OISC—25/1/2300/230/460
1—2500 KVA Gen. Elec. 60/3/22000/2200 V

3 phase, 60 cycle, 220/440 Volts

HP	Make	Type	RPM	Serial No.
15	Westinghouse	CS	1200	1883285
15	Westinghouse	MS	1200	9445931
20	Westinghouse	CS	1200	2160500
20	Westinghouse	MS	1200	1050826
20	Westinghouse	CS	1800	1863526
20	Westinghouse	CS	1800	2695044
25	Westinghouse	MS	1800	1562026
25	Westinghouse	MS	1800	1334763
25	Westinghouse	CS	1200	2286768
25	Westinghouse	MS	1200	1197673
25	Wagner	BP	1200	126906
30	Westinghouse	MS	1200	1197674
30	Fairbanks-Morse	V-H-10D	1800	43476
40	Westinghouse	CS	900	1896969
40	General Electric	I-K	1800	73318
40	Westinghouse	MS	1800	1506806
40	General Electric	I-K	1200	181444
40	Westinghouse	MS	1200	1027421
50	Westinghouse	MS	1800	1289389
50	Westinghouse	MS	1200	854410
50	Westinghouse	CS	1800	2691183
50	General Electric	14	1800	181444
50	General Electric	KT-352	720	
50	Allis Chalmers		1800	3K28825
60	Reliance		1200	B11458
60	General Electric	I	1800	292596
60	Westinghouse	CCL	1800	329654
60	Robbins-Myers	K	1800	P515362
60	Triumph		1800	C14248
60	Westinghouse	CCL	1200	854121 (2200 v.)
100	Westinghouse	CCL	1800	1043213
100	Westinghouse	CCL	1800	765231 (2200 v.)
125	Westinghouse	CS	1200	2318625
150	Westinghouse	CS	1800	2429726
150	Westinghouse	CCL	900	438385
150	Westinghouse	CS	1200	4572596 (2200 v.)
150	General Electric	I-K	1200	
150	Westinghouse	CCL	720	808349 (2200 v.)
200	General Electric	I-K	900	232917 (2200 v.)
200	Westinghouse	CCL	900	919537 (2200 v.)
250	General Electric	I-K	600	2246834
300	General Electric	I-K	720	2357743
400	General Electric	I-K	900	2347845

SLIP RING MOTORS
3 phase, 60 cycle, 220/440 Volts

HP	Make	Type	RPM	Serial No.
20	Westinghouse	CW644C	675	8009992
20	General Electric	MT332	545	3889010
30	Westinghouse	HF	1745	4558408
40	Westinghouse	CW748	690	4406823
250	Allis Chalmers	3 bearing	595	104390 (2300 v.)
400	General Electric	I-M	900	224674
400	General Electric	I-M	900	246762

MAGNETIC CONTACTOR

1—300 H.P. Cutler Hammer, Across the Line Contactor. 3 Phase, 25 Cycle 440 Volts.

25 CYCLE GEARHEAD MOTORS

1—10 HP. Westinghouse Frame [illegible] 1800 478 RPM.
15 HP Master Frame 405 Enclosed 1400/410 RPM

SPECIAL DC MOTORS

1—40 H.P. Reliance Ball Bearing Drip Proof Type T-385-T 230 V D.C. 400/1500 RPM.
1—125 H.P. Gen. Elect. 230 V. D.C. Motor. 1750 RPM.
1—40 HP Reliance Variable Speed 230 v. DC. Dripproof Ball Bearing 400/1500 RPM.
1—45 HP. G.E.

MOTOR GENERATOR SET

200 KW Westinghouse Synchronous. Generator Type SK 201, 250 V. D.C. 800 Amps. 900 RPM Motor. 290 HP. Synchronous. 3 Phase 60 Cycle 900 RPM. Can be wound for 440 V. or 2200 V. Complete with panels, exciter, and starting equipment.

CAPACITORS

3—30 KVA Gen. Elect. Pyranol Filled Capacitors 2/60/2300 v.
3—60 KVA Gen. Elect. Pyranol Filled Capacitors 3/60/2300 v.

ERIE ELECTRIC CO., INC.

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IND. FREQUENCY CHANGERS SETS

MOTOR GENERATOR SETS
ALTERNATORS ALL FREQUENCIES
TRANSFORMERS LARGE STOCK
D. C. GENERATORS ALL VOLTAGES
CONTROL EQUIPMENT

ALL SIZES, VOLTAGE AND CYCLES

3 ph. 60 cy. A. C. Motors
3 ph. 25 cy. Motors
125 Volt D. C. Motors
230 Volt D. C. Motors
550 Volt D. C. Motors

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POWER EQUIPMENT COMPANY

OIL—AIR CIRCUIT BREAKERS

4—600 A GE FK 12 3 PST 15,000 V. Handle. Trip Coils and Currents.
1—800 A Conduit E4 600 V. 3 PST Handle. Trip Coils and Currents.
1—1200 A. GE FK 132 A 3 PST 7500 Handle with Trip Coils and Current Transformer.
1—2000 A GE CK 3 Air Breaker 3 PST 600 V. O. I. & U.V.
1—3000 A GE FR 25 Oil Breaker 3 PST 600 V. Solenoid operated with currents.

Sq. Cage—220/440 V. 60 Cy. 3 ph.

Qu.	HP	Make	Type	Speed
2	50	G.E.	KT-327	1800
2	100	G.E.	IK	1800
1	150	West.	CS	1800

Slip Ring—220/440 V. 60 Cy. 3 ph.

1	40	West.	CW	720
1	50	G.E.	I-M	900
1	60	G.E.	I-M	900
1	75	West.	CW	900
1	250	West.	CW	1200

D. C. Variable Speed 230 V.

1	15	West.	SK	400/1600
1	25	West.	SK	440/1200
1	50	West.	SK	500/1500
1	50	G.E.	CD	400/1600

SEVERAL HUNDRED OTHER ITEMS IN STOCK
ABOVE ONLY SPECIALS—ALL REBUILT—STOCK SHIPMENTS

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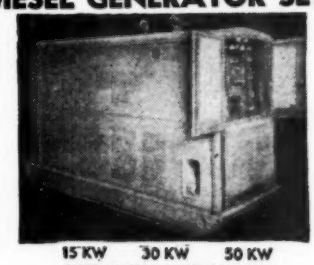
PORTABLE DIESEL GENERATOR SETS



15 KW 30 KW 50 KW
INTERNATIONAL UD-14—UD-18
BRAND NEW—SPOT DELIVERY
RADIATOR COOLED—SKID MOUNTED
60 cycle 127/220 volts
50 cycle 230/400 volts
SPECIAL PURCHASE BARGAIN

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Port Washington, Long Island, N. Y.
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200 K. V. A.

WESTINGHOUSE A.C. GENERATOR

240 Volts, 3 Phase, 60 Cycle, 600 RPM, Serial 1169896, Style 159082 with Direct Connected Type SK 70L Exciter, 125 Volts 600 RPM.

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THE MOTOR POWER CO. OF NEW YORK, INC.

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RHinelander 4-6478

7—Westinghouse Flex-Arc Welders, 400 Amps. 40 Volts. Motors: 3 220 Volts, 60 Cyc.

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ELECTRIC APPARATUS REPAIR CO.
1400 N. 6th Street, Phila. 22, Pa.

SYNCH. CONVERTERS

500 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
500 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
150 KW WEST. 250 D.C. 2300/40000 A.C. 1200 RPM

MOTOR GENERATORS

200 KW WEST. SYN. 250 V. 2300/4000 A.C. 900 RPM
150 KW G.E. SYN. 250 V. 2300/4000 A.C. 900 RPM
150 KW G.E. SYN. 600 V. 2300/4000 A.C. 1200 RPM

Each unit listed above is owned by us and is available now for immediate purchase

WALLACE E. KIRK CO.

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502 Grant Building, Pittsburgh, Pa.

PUMPS

Rebuilt & Guaranteed

PUMPS—Large stock centrifugal—turbine—piston.

STEAM PUMPS—Duplex - Simplex. Reconditioned and guaranteed.

BOILERS—stacks—Engine Generators—condensers.

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PUMP & MACHINERY COMPANY
715 Howard St. St. Louis 6, Mo.
Telephone - GArfield 4290

BOILERS-TURBINES

2—400 H.P. Erie City, type-E, stokers, OHIO, PENN'A & ASME stamping.
2—400 H.P. Springfield, oil burners, N. J. & ASME stamping.
2—25,000#, per hour, 425#, 650 T.T. boiler & turbine complete plant (1) 1500 KW. bleeder, (1) 1500 K.W. back pressure turbo's, National Board boilers.

H. P. BREARLEY
3423-91st Street
Jackson Heights, N. Y.

APPLICATION ENGINEERS

3000 KW 200 lb. GE Cond. Turbine Set.
2—140,000 lb. Cap. 650 lb. WP Boilers.
200 KVA 480 Volt AC Ridgway 4-Valve Eng. Set.
360 HP 240 Volt AC Fairbanks Morse Diesel Set.
180 HP 2300 Volt AC Fairbanks Morse Diesel Set.
100 HP Fairbanks Morse Diesel Engine with Clutch.
50 KW M.G. Set 440 AC to 250 DC.

HOWARD B. JOHNSON & ASSOCIATES
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BOILERS

12—30,000# Foster Wheeler 475# pressure boilers with oil burners, 1942.
2—600 HP Springfield Sectional Headers, 200# pressure, rebuilt.
3—768 HP Stirling Boilers, 200# pressure.
1—256 HP Stirling Boiler 160# pressure, new tubes, stoker.

TURBINES

2—5000 KW Westinghouse 3600 RPM 3/60/2300 volts Condenser, all auxiliaries.
2—15,625 KVA General Electric Condensing Turbines.
1—3700 KVA General Electric Condensing Turbine.
1—300 KVA General Electric Condensing Turbine.

DIESEL ENGINES

3—300 KVA Fairbanks-Morse Full Diesel Engines.
3—200 KVA Fairbanks-Morse Full Diesel Engines.
1—350 KW Burch Sulzer 3-60-2300 Volt, all auxiliaries.
2—300 KVA Fairbanks Morse Full Diesel Engines.
1260 KVA Nelesco engine generator.

ENGINE GENERATOR SETS

1—750 KVA Corliss Engine Generator Set.
1—565 KVA Skinner Uniflow Engine Generator.
1—375 KVA Harrisburg Uniflow Engine.
1—150 KW Skinner Uniflow Engine Generator Set A.C.
1—600 KW Skinner Vertical A.C. Generator.
1—500 KW Non Releasing Corliss, 3-60-240 volts.

MISCELLANEOUS

90,000# Cochran deaerating feed water heater.
2500 HP Cochrane Open Feed Water Heater.
1—10' x 15' Illinois Forced Draft Chain Grate Stoker.
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6 phase 60 cycle

Qu.	KW	Make	Speed	D.C.V.	Trans. V.
1	1500	Whse.	450	250	2300/4160
1	500	Whse.#	1200	250	2300
2	500	GE	1200	600	##
1	500	Whse.	1200	600	##
1	300	Whse.	1200	275	##
2	300	GE	1200	275	##
2	300	Whse.	1200	600	##
2	150	Whse.	1200	275	##

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2— 600 H.P. Edge Moor 200# Stokers
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9700	110'	Ing Rand	Centrif
6000	33'	LeCourtenay	Centrif
3500	140'	Kingsford	Centrif
3000	33'	LeCourtenay	Centrif.
1400	140'	Cameron	Centrif
1100	220'	Allis-Chalm	Centrif
1500	160'	De Laval	Centrif
400	625'	LeCourtenay	Centrif
250	525'	LeCourtenay	Centrif
400	350'	Goulds	Triplex
300	500'	Goulds	Triplex
175	500'	Goulds	Triplex
500	175'	Blackmer	Rotary
450	231'	Kinney	Rotary
300	150'	Viking	Rotary
1000	460'	Knowles	Steam
750	460'	Snow	Steam
600	100'	Foster	Steam
300	231'	Gardner	Plunger

M. G. & STEAM DR. SETS

K.W.	Make	Volts	Type
25	Green Eng.	220 D.C.	Belt Drive
2	Gasoline Eng.	120 A.C.	Dir. Drive
6½	Gasoline Eng.	120 A.C.	Dr. Drive
17	Sturt Turbine	110 D.C.	Direct Drive
7½	Sturt Turbine	110 D.C.	Direct Drive

D.C. MOTORS ALL SIZES

100 Northwest	220	1750
25 Roth	230	1750
10 Crock. Wheel.	110	925
10 Weschge	110	1700
1½ to 7½ H.P.	All Makes	

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500	60	Ing. Rand	Steam
400	125	American	Horiz.
350	40	Worthing	Horiz.
140	125	Curtis	Vert. Dup.
220	100	Gardner	Vert. Dup.
28	5000	Norwalk	4-Stage

TURBO-CENTRIFUGAL BLOWERS

1800	5¼ lbs.	Ing Rand	Motor dr.
1300	16 oz.	North American	Motor dr.
1100	16 oz.	Fisher	Motor dr.
900	10½ lbs.	Ing Rand	Motor dr.
900	5¼ lbs.	Ing Rand	Motor dr.
400	16 oz.	Spencer	Motor dr.
250	16 oz.	Spencer	Motor dr.

BLOWERS & EXHAUSTERS

C.F.M.	St. Pres.	Make	Type
100 60000	½"–5"	Buffalo	Various
100 15000	½"–16 oz.	American	Various

ROTARY PRESSURE BLOWERS

C.F.M.	Press	Make	Type
6000	3 lbs.	Roots	Belt dr.
3000	3 lbs.	Roots	Belt dr.
2000	3 lbs.	Sturt.	Belt dr.
1000	3 lbs.	Roots	Belt dr.
500	3 lbs.	Roots	Belt dr.
235	1 lb.	Fuller	Direct dr.
110	15 lbs.	Beach R	Belt dr.

VACUUM PUMPS

1000	15 in.	Roots	Belt dr.
350	27 in.	Worth	Belt dr.
100	high vac.	Beach R	Gear dr.
100	27 in.	Deane	Belt dr.
100	29 in.	Devine	Belt dr.
100	20 in.	Nash	Direct dr.

MOTORS (3 ph. 60 cy.)

HP	Make	Volts	Speed	Type
150	West.	440	700	CS
100	Lincoln	220	1750	
50	G. E.	2300	1750	I
50	West.	220	850	CCL
50	West.	220	570	CS
30	Burke	220	1150	342
40	G. E.	220	870	Slipring.
30	Wagner	220	850	Sl. rg.

Also 10 to 30 H.P. in All Makes

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6½" Bore x 7" Stroke
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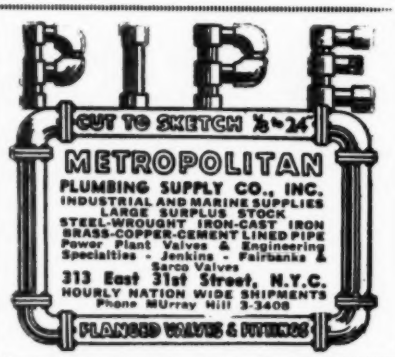
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50 HP GE, MTC 5542 600 RPM
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30 HP GE, ITC 5010 900 RPM
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Intake Press..... 0 lbs. gauge
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Actual .....70.6 cu. ft. per min. referred to intake.
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1—Westinghouse DC Motor type S 5 HP 220 V 21 amp 1300 RPM Ser. #112692.

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1—Shepard Littabout Electric Hoist 2,000 lb. capacity 230 V DC Ser. #11339.

1—Wright Electric Hoist 1,000 lb. capacity 230 V DC 1200 RPM Ser. #27668.

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2—G. E. CP 27 Compressor Head Air Pumps 230 V DC Complete with pressure line switches.

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1—Westinghouse DC Motor 10 HP 40 amp 230 V 1725 RPM Frame 60L Ser. 143833.

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Manning, Maxwell, & Moore 47'4" Span
Shaw 36' Span
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American 47'4" Span
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American 77' Span
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10-Ton
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Morgan 52'3" Span
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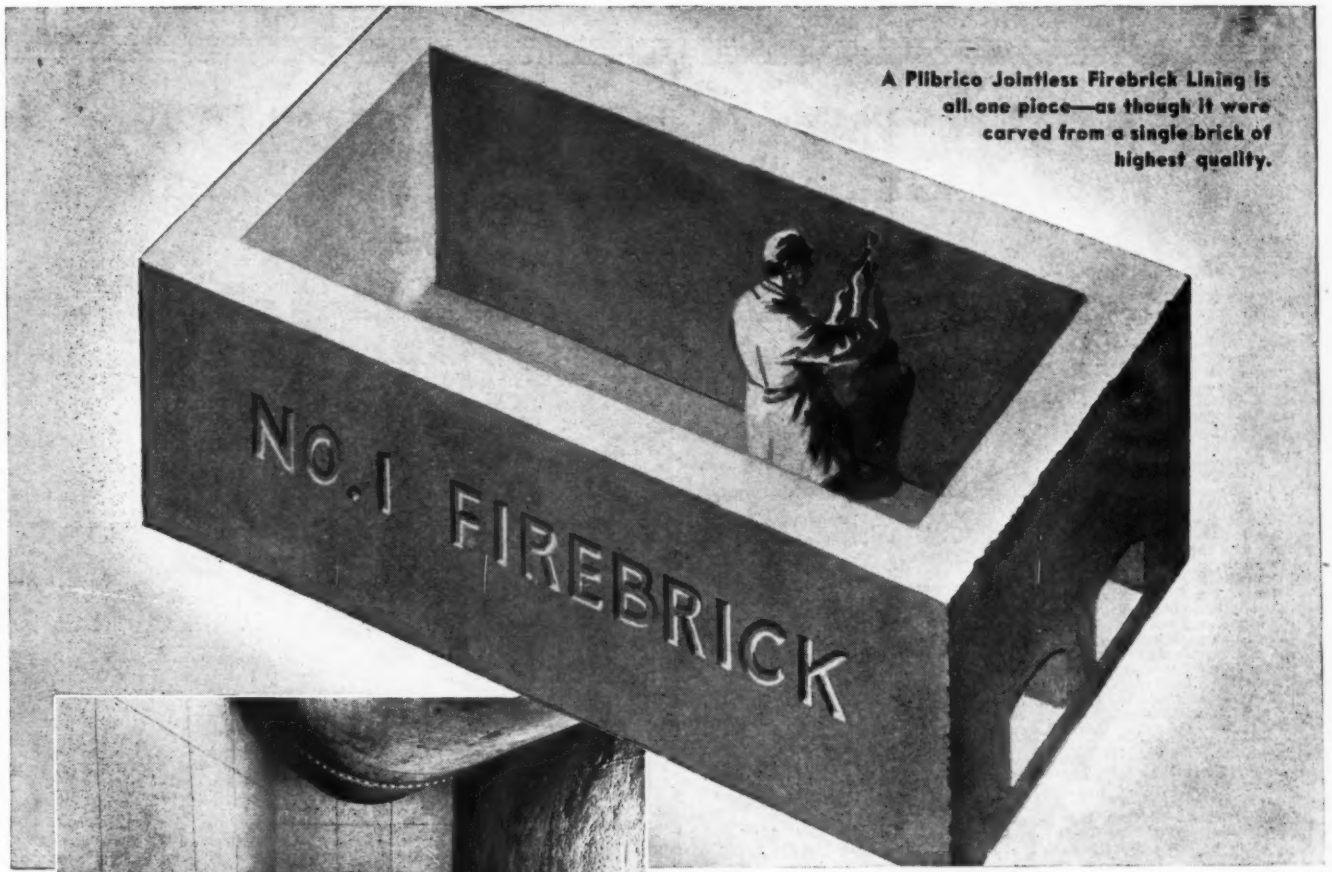

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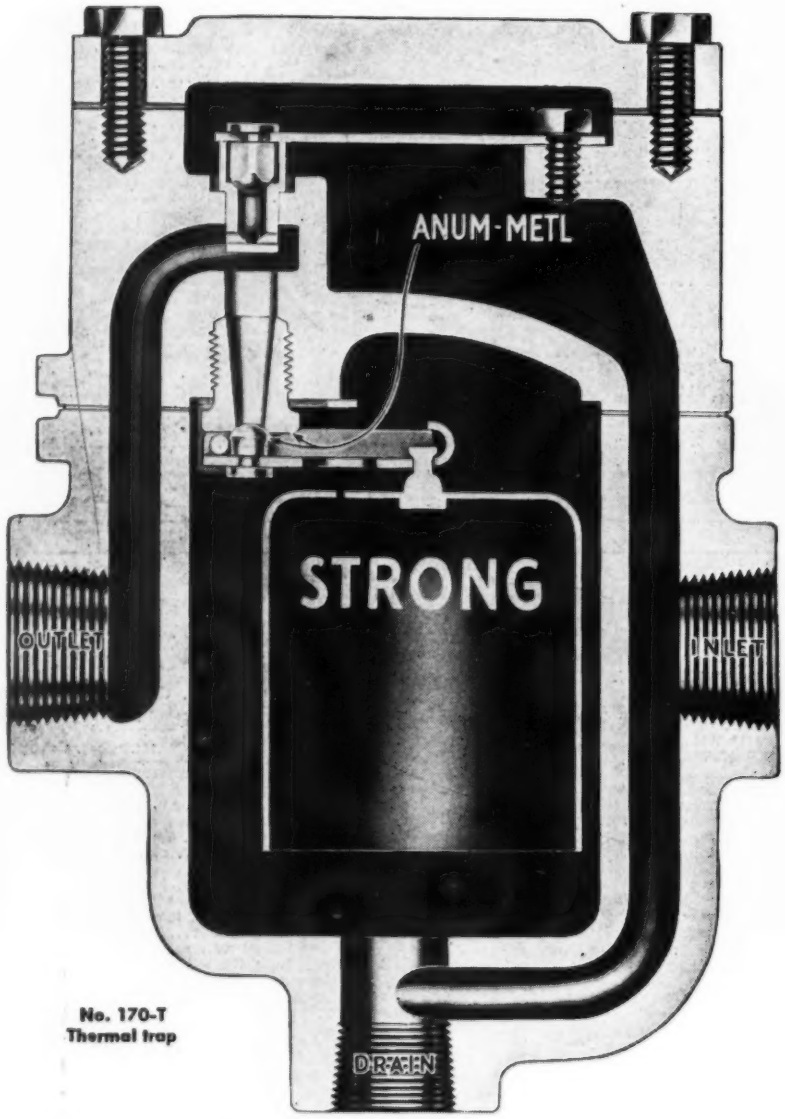

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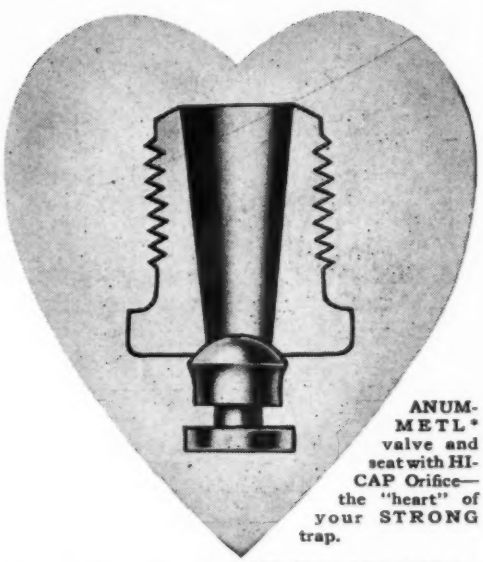

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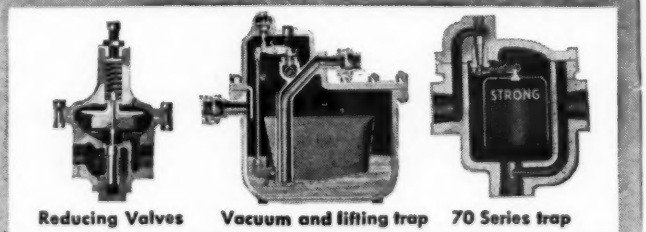

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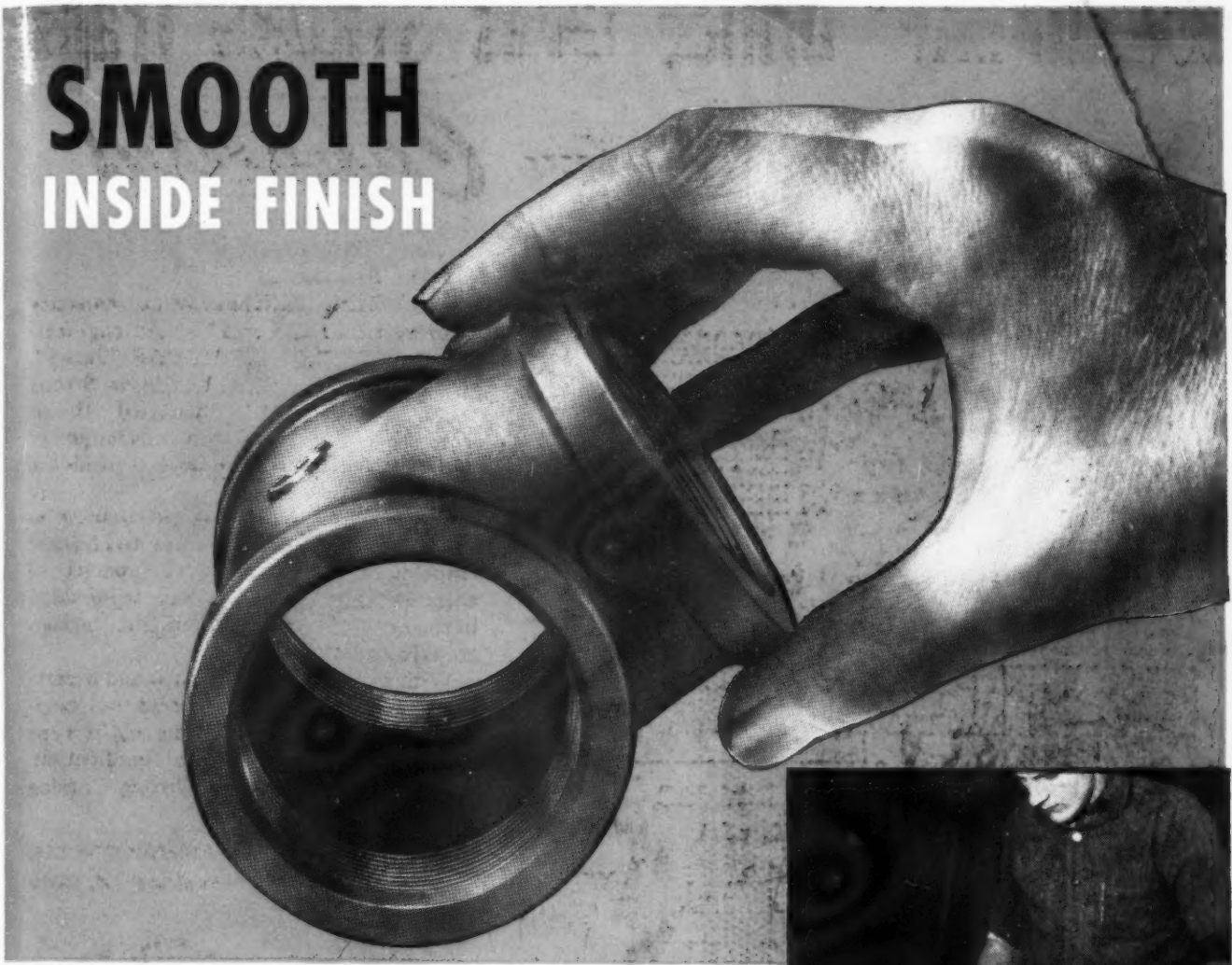

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